MODEL 650TA

calibration/maintenance plug-in unit

MANUAL # 110-6008

SINGER
INSTRUMENTATION

MODEL 650TA

ALFRED ELECTRONICS

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INSTRUCTION MANUAL

MODEL 650TA

calibration/maintenance plug-in unit

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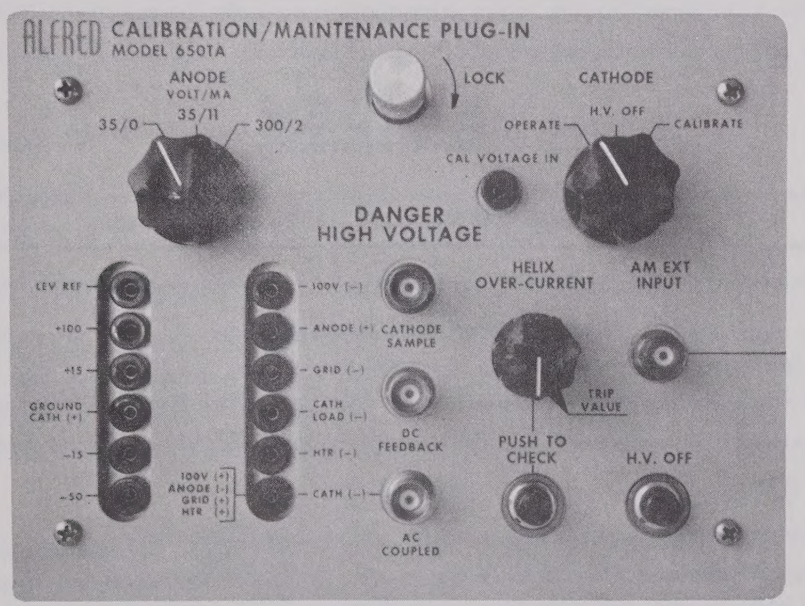

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The Singer Company, Palo Alto Operation

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Instruments should be returned only on prior written authorization from the Singer Representative or the factory(1). Please provide the following information in order to expedite our processing of your instrument:

1. Model or Type
2. Serial Number
3. Approximate date instrument was placed in operation
4. Approximate number of hours of use
5. Description of trouble(2)
6. Has maintenance action been previously requested?
7. Other comments

Upon receipt of this information our Service Department will send you service data or shipping instructions. Upon receipt of shipping instructions forward the instrument prepaid to the specified center or factory. If requested, an estimate of charges will be made before work begins.

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(2) Include data on symptoms, measurements taken, test instruments used, suspected location of trouble, maintenance action taken, and any other relevant data.

MANUAL CHANGES

FOR

CALIBRATION/MAINTENANCE PLUG-IN
MODEL 650TA

Make corrections to errata listed below and make applicable changes(s) listed in the table below according to instrument serial number.

SERIAL NO.	MAKE CHANGES

SERIAL NO.	MAKE CHANGES

ERRATA: Table 3-2, Group 1:

Under "DC Voltage & Tolerance" heading, change +100V tolerance to $\begin{matrix}\text{"}+4\text{V"}\\ -1\text{V}\end{matrix}$.

Paragraph 3.5.6:

Step i:
Change "99%" to read "98%".

Step j:
Change "A mid-scale position" to " the 0% position".

Add the following paragraph 3.7 on the blank page facing page 4-1.

3.7 USE OF MODEL 650TA TO CHECK MODEL 9511. In a system where Model 650 is used with Model 9510/Model 9511 to provide multiband operation, the Model 650TA can be used to check the power control functioning of any Model 9511 plug-in opening.

CAUTION

The Model 9511 contains a 1.2A fuse to protect the output of each standby heater supply. To avoid blowing this fuse when a Model 650TA is used in the plug-in unit opening, one of the 8068 load tubes shown in Figure 5-1 must be removed from the Model 650TA before it is inserted into the Model 9511.

Paragraph 5.2.2.1, step b, should read: "resistance reading should be approximately 0.5 Ω if the Model 650TA has not been operated for two hours. If the unit has recently been operated, so that the tube heaters are warm, resistance should be approximately 3.5 Ω "

D.K Paragraph 5.2.2.7, step c, change the resistance tolerance from "100k Ω" to "100 Ω".

? Paragraph 5.2.4, step b, change "HEATER LOAD" to CATHODE".

June 3, 1971

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SECTION 1

GENERAL INFORMATION

1.1 SCOPE OF MANUAL.

This Manual covers the ALFRED Model 650TA Calibration/ Maintenance Plug-in unit which permits the Model 650 Sweep Oscillator to be calibrated in the field in accordance with factory-approved procedures.

This manual should be used as a supplement to the basic Model 650 Instruction Manual. That manual includes all necessary basic information for operating the Model 650 with any plug-in unit installed. This plug-in manual gives instructions for checking and calibrating a Model 650 unit using the 650TA plug-in, and provides supplemental descriptive and theory information and self-calibration instructions pertinent to the calibration plug-in unit.

1.2 DESCRIPTION OF MODEL 650TA PLUG-IN UNIT.

The plug-in unit is a modular assembly designed to operate with the ALFRED Model 650 to constitute a self-contained calibration unit. The dial plate supplied with the Calibration Plug-in unit is calibrated in percent on a linear scale from 0% to 100%, corresponding to increments of cathode supply output voltage over a linear range of -150 V to -2500 V. The unit contains all necessary output jacks for monitoring pertinent circuit test points on an oscilloscope or digital voltmeter.

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The Model 650TA (serial 98 and above) differs from the Model 650T (serial 97 and below) in that the Model 650TA itself can be calibrated in the field, with instructions provided in this manual. The Model 650T must be returned to the factory for calibration.

1.3 APPLICATIONS OF MODEL 650TA PLUG-IN UNIT.

The Model 650TA Calibration Plug-in unit, when used with the Model 650, provides a means of factory-calibrating the 11 "critical" adjustments described in paragraph 5.3.2 of the Model 650 Instruction Manual. The 6 "periodic recalibration adjustments" described in paragraph 5.3.3 of that manual can also be calibrated using the Model 650TA. Calibration with the Model 650TA is of particular importance when more than one rf-type plug-in unit is used with the Model 650 because the Model 650TA has a smaller tolerance than any individual rf plug-in unit. Thus, the Model 650TA calibrates performance throughout the operating range within the specification tolerance of all plug-in units.

Since the Model 650TA controls the Model 650 cathode supply to develop a linear voltage output ranging from -150 V to -2500 V, it also permits use of the Model 650 as an auxiliary linear high voltage supply for applications involving VTM's and other tubes requiring linear voltage drive between any selected limits within the 0.15 to 2.5KV range.

WARNING

NOTE → Use of the Model 650TA to check and calibrate the Model 650 involves measurement of voltages in the 2.5 KV range with respect to ground. It also involves measurement of other voltages which are referenced to the 150V - 2.5KV cathode supply and must be measured using floating or differential techniques. Exercise extreme caution whenever high voltage is turned on.

SECTION 2

INITIAL INSTRUCTIONS

2.1 GENERAL.

Refer to Section 2 of the Model 650 Instruction Manual.

CAUTION

When an rf-type plug-in unit is removed from the Model 650 to permit installation of the Model 650TA plug-in unit, note that the rf-type plug-in unit contains a strong permanent magnet. Make sure the rf-type plug-in unit is kept at least six inches from magnetic materials. STORE RF-TYPE PLUG-IN UNITS IN A SUITABLE SHIELDING CONTAINER, SUCH AS THE ALFRED MODEL 9000 STORAGE CONTAINER, OR ON WOOD AND AT LEAST SIX INCHES FROM MAGNETIC SOURCES.

SECTION 3

OPERATING INSTRUCTIONS

3.1 REMOVAL, INSTALLATION, AND INTERCHANGING OF PLUG-IN UNITS IN THE MODEL 650.

3.1.1 REMOVAL OF A PLUG-IN UNIT FROM THE MODEL 650. To remove a plug-in unit from the Model 650, release its panel LOCK knob by turning fully CCW, and then pull the unit out of the Model 650 by pulling on the LOCK knob. Remove the frequency * dial plate for that plug-in unit from the Model 650 panel and attach to the underside of the storage compartment door in the top of the plug-in unit, using the knurled screws which are captive to the plate. (See Figure 2-1 of the Model 650 Instruction Manual.)

3.1.2 INSTALLATION OF A PLUG-IN UNIT IN THE MODEL 650. To install a plug-in unit in the Model 650, first remove the frequency * dial plate from the storage compartment door of that plug-in unit and install it into the calibrated position on the Model 650 panel. (See Paragraph 2.6 and Figures 2-1 and 3-1 of the Model 650 Instruction Manual.) Make sure the plug-in unit LOCK knob is turned fully CCW so the lock arm will clear the Model 650 panel opening and will enter far enough to actuate the safety interlock switch. Then insert the plug-in unit through the Model 650 panel and lock in position by pushing in on the LOCK knob and turning it fully CW.

3.1.3 INTERCHANGING PLUG-IN UNITS IN THE MODEL 650. To interchange plug-in units, follow the procedure of Paragraphs 3.1.1 and 3.1.2 above. The Model 650 is properly calibrated for operation with the new plug-in unit by installation of the frequency * dial plate for that unit. No adjustments are required.

3.2 FUNCTIONS OF PANEL CONTROLS, INDICATORS, AND CONNECTORS.

See Tables 3-1 and 3-2 of the Model 650 Instruction Manual for basic information about these items on the main Model 650 chassis. Note that when operating with the Model 650TA plug-in, the F_1, F_2, F_0, M_1, and M_2 controls set voltage points, rather than frequency points, in accordance with the indicator positions on the calibration dial plate.

Functions of controls and terminals on the Calibration Plug-in unit are listed in Table 3-1 below.

3.3 USE OF THE MODEL 650TA TO CHECK AND ADJUST LOW VOLTAGE POWER SUPPLIES IN THE MODEL 650

3.3.1 GENERAL. The front panel of the Model 650TA Calibration Plug-in unit contains tip jack test points which monitor the supply outputs of the Model 650. With the aid of the 650TA front panel controls, a complete check of the Model 650 power supplies can be performed. Adjustments can then be made as necessary. If supply outputs are not within the prescribed limits and/or cannot be properly adjusted, check for defective components in accordance with the troubleshooting procedures in the Model 650 Instruction Manual. Locations of Model 650 adjustment controls referred to in the paragraphs below are shown in the illustrations of Section 5 of the Model 650 Instruction Manual. Refer to Table 3-3 for suitable test equipment.

3.3.2 CHECKING THE LOW VOLTAGE SUPPLIES. Set the Model 650TA CATHODE switch to H.V. OFF. This will cut off high voltage in the Model 650. The low voltage supplies (-15 V, +15 V, -50 V and +100 V) and the LEV. REF. signal can now be checked directly from the front panel jacks and adjusted where applicable, in accordance with Group 1 of Table 3-2. When the measured value falls anywhere within the tolerance range indicated, no adjustment should be performed. The -15 V supply serves as a reference for the other supplies, and must be calibrated before checking the other supplies. Use A2R18 for calibration adjustment of the -15 V supply, and A2R9 for calibration adjustment of the +15 V supply.

3.3.3 CHECKING THE HEATER SUPPLY. Proceed as follows:

a. Set the Model 650TA CATHODE switch to H.V. OFF. This will provide proper heater supply load and cut off high voltage in the Model 650 to permit safe connection of the voltmeter.

b. Connect a lead from the HTR (-) tip jack to a 0.01% digital voltmeter, with the voltmeter return lead to the HTR (+) tip jack.

c. Set the line voltage to 115 V.

d. The heater supply output voltage should be 6.3 V ±0.2 V. If necessary, adjust A6R21 slightly to achieve this output level.

e. Set the line voltage to 103 volts with a Variac. and note the output voltage.

f. Set the line voltage to 127 volts and note the output voltage.

g. The change in output voltage between steps e and f should be < 10 mv.

h. Connect a floating oscilloscope vertical input probe to the HTR (-) tip jack with the return lead to the HTR (+) tip jack and check the supply ripple. Peak-to-peak ripple should be less than 10 mv.

NOTE: If the heater supply output does not remain regulated over the line voltage limits given above, or if the output level cannot be set properly with A6R21, check for defects in the supply.

* The "frequency" dial plate supplied with the 650TA is calibrated in % of full scale, and is referred to in later paragraphs of this manual as the calibration dial plate.

Table 3-1. Functions of Model 650TA Front Panel Controls and Terminals

Control or Terminal	Function
ANODE (VOLT/M.A.) Selector Switch	Used to check the Anode Supply of the Model 650 over its full operating voltage range of +35 V to +300 V, with internal loading appropriate to simulate the actual tube load at each end of the range.
CATHODE Mode Selector Switch	Controls the operating mode of the Model 650 and Model 650TA Plug-in unit as follows: In OPERATE position, enables high voltage supplies in the Model 650 and provides proper internal load within the Model 650TA for the cathode and heater supplies. This mode is used for test and calibration of the high vo-voltage supplies and for operation of the Model 650 as a H.V. power supply. In H.V. OFF position, disables high voltage supplies in the Model 650 to permit safe testing and calibration of the low voltage supplies including the heater supply. The Model 650TA provides a proper internal load for the heater supply. In CALIBRATE position, keeps the high voltage supplies disabled, and connects the diode shaper PC board A13 inputs and outputs to special circuits to permit field calibration of the Model 650TA.
HELIX OVERCURRENT Control and PUSH TO CHECK Button	Used to check the helix overcurrent trip-out protective circuit. When turned CW, increases the simulated helix current by means of an internal current source. When turned fully CW to the switched TRIP VALUE position, provides the proper trip current. If the helix overcurrent relay trips at any other point, the protective circuit requires adjustment.
H.V. OFF Pushbutton	Provides a convenient means of turning off the high voltage supply to allow safe changing of test connections. When pressed, trips the protection circuits to shut off the High Voltage Supply. To restore the high voltage supply outputs, press the HIGH VOLTAGE RESET button on the Model 650 panel.
CATHODE SAMPLE BNC Jack	Provides a ground-reference sample of the low voltage dc feedback applied to the diode shaper PC board A13 from the feedback dropping resistor PC board A25. Permits monitoring the "diode shaper input" signal for calibration of the Model 650TA (use high impedance meter only).
DC FEEDBACK BNC Jack	Provides a ground-referenced sample of the low voltage dc feedback applied to the cathode supply summing junction from the diode shaper PC board A13. Permits monitoring the "diode shaper output" signal for calibration of the Model 650TA (use high impedance meter only).
AC COUPLED BNC Jack	Provides a ground-referenced capacitor-coupled connection to the cathode supply to permit checking the ripple of the cathode supply output without a special high voltage probe.
AM EXT. INPUT BNC Jack	Permits an external signal to modulate the grid voltage to allow checking the response of the modulator and transfer oscillator.
CALIBRATION VOLTAGE IN Tip Jack	Permits an external dc drive voltage to be applied to the diode shaper PC board A13 for field calibration in the CALIBRATE mode.
Test Point Tip Jacks WARNING Lethal voltages are present at the right-hand column of red high voltage tip jacks. Use insulated, high voltage probes when making measurements at these jacks. High voltage and/or floating meters are required for each measurement, as specified in Groups 2 and 3 of Table 3-2.	Provide a convenient means of monitoring important voltages without removing any panels from the Model 650 cabinet. The left-hand column of tip jacks, with black panel markings, are for low-voltage measurements, and monitor the LV supplies and leveler reference (A5-R) voltages. The right-hand column of tip jacks, with red panel markings, are for high voltage measurements, and monitor the high voltage supplies and tube modulation outputs. The function of each tip jack is covered more fully in Table 3-2.

Table 3-2. Voltage Measurements at Model 650TA Front Panel Tip Jacks

GROUP 1 - Left-hand column of tip jacks, with black panel markings. The output of each of these jacks must be measured with respect to the GROUND, CATH (+) Black Tip Jack with a 0.01% Five-Digit Digital Meter (listed in preferred order of measurement).

Supply	TP#	DC Voltage & Tolerance	AC Ripple
-15 V	-15 V	-15.000 ± 0.005 V (see paragraph 3.3.2 of Model 650 manual for calibration adjustment)	500 µv maximum
+15 V	+15 V	+15.000 ± 0.005 V	500 µv maximum
+100 V	+100 V	+100.0 - IV + 4V	500 µv maximum
-50 V	-50 V	-50 ± 2 V	500 µv maximum

NOTE: Use oscilloscope for measurement of ac ripple.

Signal	TP#	DC Voltage & Tolerance	
Leveler reference from Modulator	LEV. REF.	<0.003V with MODULATION Mode Selector set to AM EXT and no modulation applied.	-
		-0.300 ± 0.012 V with MODULATION selector OFF and FREQUENCY selector at SINGLE.	-

GROUP 2 - Bottom right-hand "CATH (-)" red tip jack. The output of this jack is measured with respect to the GROUND, CATH (+) Black Tip Jack with a High Voltage Digital Meter or Suitable Voltage-Divider Probe.

Supply	TP#	DC Voltage & Tolerance	AC Ripple
Cathode	CATH (-)	(-150 to -2500 V; see paragraph 3.5 for specific measurements and tolerances.)	50 mv maximum with output set to -2500 V; 15 mv maximum with output set to -150 V. See paragraph 3.5.7 of this manual.
		WARNING	
		High Voltage. Use extreme caution.	CAUTION
			Use AC COUPLED BNC connector for ripple measurement.

GROUP 3 - Right-hand column of tip jacks, with red panel markings. The voltages monitored must be measured with a suitable digital voltmeter between two red tip jacks, requiring that the cathode supply be disabled and grounded as described in paragraph 3.4.1.

WARNING

If the cathode supply is not disabled, each of these voltages is elevated at cathode potential and floating meters must be used. Use extreme caution.

Supply	TP# to TP#	Voltage	Notes
Heater (voltage)	HTR (+) HTR (-)	6.3V ± 0.2V (with 1.8 ampere load)	Measure with high-voltage off. See paragraph 3.3.3 of Model 650 manual for calibration adjustment.
-100 V	100 V (+) 100 V (-)	100 ± 0.1 V	FREQUENCY Mode Selector switch on SINGLE, no modulation. See paragraph 3.3.4 of Model 650 manual for calibration adjustment.
Anode	ANODE (+) ANODE (-)	35 or 300 V, depending upon setting of ANODE VOLT/MA switch.	
Transfer Oscillator Output and Elevated Supply Drive	GRID (+) GRID (-)	95 ± 5V (at GRID (-))	with controls set for RF OFF
		<0.3V	with controls set for RF ON

NOTE: The CATH LOAD (-) red tip jack is used for calibration of the Model 650TA, to monitor the operating of the cathode load tubes. Its use is described in Section 5.

Table 3-3. Recommended Test Equipment for Calibrating Model 650 Using Model 650TA

Instrument	Important Characteristics	Manufacturer & Model
High Voltage, Insulated Digital Voltmeter*	0 to > 3 KV range, 5-digits, 0.1% accuracy	Cimron Model 7200A Voltmeter with Model 6930A 10 KV Plug-in Unit
Low Voltage Digital Voltmeter *	0 to +150 V range, 5-digits, 0.01% accuracy	Cimron Model 7200A Voltmeter with Model 6900A Input Assembly (or Model 6930A 10 KV Plug-in Unit) or Hewlett-Packard Model 3459A
Oscilloscope	DC to 15 MHz performance; accept differential comparator plug-in unit with scale offset	Tektronix Type 531A or 533A
Oscilloscope Differential Comparator Plug-in Unit	1 mv/cm to 50 mv/cm deflection sensitivity 1 to 1000X attenuation Comparison offset voltage: > 10,000 cm effective screen height	Tektronix Type W or (Type Z + Type 1121 100X Amplifier)
Oscilloscope 1000X Voltage-Divider Probe (for measurement of swept HV cathode supply output)	1000X attenuation > 3 KV DC or peak pulse voltage rating	Tektronix P6013A
Oscilloscope 10X Voltage-Divider Probe	10X attenuation 600 V DC or DC + AC peak voltage rating	Tektronix P6006 or P6023
Metered Variac	103 V - 127 V ac range, 5 amps rated current	General Radio W5MT3 Variac
Digital Ohmmeter*	0 to 9.999 megohms, 4 or 5 digits, 0.1% accuracy or better	Cimron Model 7200A Voltmeter with Model 6910A or 6911A Ohms Converter
Clip-on DC Milliammeter*	1 - 50 ma range	Hewlett-Packard Model 428B

*Also used for calibrating the Model 650TA.

3.4 USE OF THE MODEL 650TA TO CHECK AND ADJUST HIGH VOLTAGE POWER SUPPLIES IN THE MODEL 650.

NOTE: The cathode supply will be checked separately in Par. 3.5.

3.4.1 DISABLING CATHODE SUPPLY TO PERMIT SAFE (NON-FLOATING) MEASUREMENT OF SUPPLIES REFERENCED TO IT.

a. With the Model 650 POWER switch turned off, remove top panel.

b. Disconnect the VIO-WHT-ORN lead (BRN-WHT-ORN on early units) from T2-5 (Terminal 5 of High Voltage transformer T2, near the top of T2 at the front, right-hand side of T2.)

CAUTION

Insulate the end of the wire or clip it out of the way to prevent it from being grounded or touching the top cover when replaced.

c. Replace the top cover panel.

d. Ground the cathode supply output by connecting a jumper between the CATH (-) and GROUND, CATH (+) tip jacks.

e. Turn the Model 650TA CATHODE switch to H.V. OFF. Turn the Model 650 POWER switch to ON.

3.4.2 CHECKING THE -100V (GRID) SUPPLY. Proceed as follows:

a. Set Model 650 controls as follows:

FREQUENCY Mode Selector to SINGLE
SINGLE Selector switch to F_0
F_0 control knob fully counterclockwise (indicator at extreme left end of dial)
MODULATION switch to OFF

b. Connect a lead from the 100 V (-) tip jack to a digital voltmeter, with the voltmeter ground return lead to the 100 V (+) tip jack.

c. Turn the -100V supply on by setting the CATHODE switch to OPERATE. Then press the HIGH VOLTAGE RESET button.

WARNING

In this procedure, it may be necessary to remove the top cover plate for access to adjustments. An insulated block or other suitable object must be used to depress the high voltage interlock switch normally actuated by the top cover plate in the installed position. Be careful not to touch exposed high voltage circuits when the top cover is removed.

d. If necessary, adjust A6R5 to obtain exactly -100 V. (Remove top cover for access to A6R5.)

e. Press the HV OFF button to remove high voltage.

f. Connect the voltmeter (-) lead to the GRID (-) tip jack instead of the 100 V (-) tip jack.

g. Press the HIGH VOLTAGE RESET button.

h. With the MODULATION switch in the AM EXT position, the voltage reading should be 95V ±5V. With the MODULATION switch set at AM OFF, the voltage reading should be 0 or <0.3V.

i. Press the HV OFF button to remove high voltage.

j. To check ripple, set the oscilloscope to ac coupling and connect its probe to the GRID (-) tip jack, with the ground return lead to the GRID (+) tip jack.

JUMPER

k. Press the HIGH VOLTAGE RESET button.

l. Monitor the ripple displayed on the oscilloscope. It should be less than 20 mv.

m. Check Square Wave rise time by turning the MODULATION switch to SQUARE WAVE and observing the oscilloscope display. Adjust the square wave rise time to a maximum of .25 μsec by adjusting A9C5.

n. Turn the MODULATION switch to AM EXT..

o. Check for excess transfer oscillator input current by attaching a clip-on milliammeter probe to the orange lead at the uppermost feedthru insulator on the transfer oscillator shield cover near the A9C5 access opening in the left-hand side of the Model 650. Input current should be less than 27 ma. If not, readjust A9C5 to reduce the current to < 27 ma.

p. If a single setting of A9C5 will not give suitable rise time performance with input current < 27 ma, remove power and check for detective components in the transfer oscillator, particularly A9Q2, A9Q4 or A9Q1.

3.4.3 CHECKING THE ANODE SUPPLY. Proceed as follows:

a. Set the Model 650TA CATHODE switch to H.V. OFF. Set Model 650 controls as in step a of paragraph 3.4.2.

b. Connect a lead from the ANODE (+) tip jack to a digital voltmeter, with the voltmeter ground return lead to the ANODE (-) tip jack.

c. Turn high voltage on by setting the CATHODE switch to OPERATE. Then press the HIGH VOLTAGE RESET button.

d. With the ANODE VOLT/MA switch in the 35/0 position, the voltage should be 35 V ± 0.5 V.

e. With the ANODE VOLT/MA switch in the 35/11 position, the voltage should be 35 V ± 0.5 V.

f. With the ANODE VOLT/MA switch in the 300/2 position, the voltage should be 300 V ± 3.0 V.

g. Using a Variac, set the line voltage first to 103 volts and then to 127 volts, and note the total change in the 300V output between 103V and 127V line. This change should be <500 mv.

h. Press the HV OFF button to remove high voltage.

i. To check ripple, set the oscilloscope for ac coupling. Connect the 10X probe to the ANODE (+) tip jack, and ground return lead to the ANODE (-) tip jack.

j. Press the HIGH VOLTAGE RESET button.

k. Monitor the ripple displayed on the oscilloscope. In all three positions of the ANODE VOLT/MA switch, the ripple should be less than 2 mv.

l. If voltage or ripple are improper in any range, remove power and check A10V4 (6CW5). Also check A6Q9 A6Q10, A6Q11 and other components in the anode supply circuit.

3.4.4 CHECKING THE HELIX OVERCURRENT PROTECTION CIRCUIT. Proceed as follows:

a. Set the Model 650TA CATHODE switch to H.V. OFF to disable high voltage.

b. Turn the 650TA HELIX OVERCURRENT control fully CCW. Then hold the PUSH TO CHECK button depressed, and observe relay A7K1 (Fig. 5-1 of Model 650 Instruction Manual) while adjusting the HELIX OVERCURRENT control toward the CW limit.

c. Relay A7K1 should not trip until just before the HELIX OVERCURRENT control reaches the CW limit (within the shaded TRIP VALUE sector indicated on the panel or in the switched position at the CW limit).

d. If the relay does not trip at all, leave the HELIX OVERCURRENT control in the switched position at the CW limit, and adjust A7R3 (while holding the PUSH TO CHECK button depressed) until relay A7K1 trips. If the relay tripped before the HELIX OVERCURRENT control reached the TRIP VALUE position, turn the control fully CW and then adjust A7R3 (while holding the PUSH TO CHECK button depressed) until the relay releases; then back off A7R3 slightly until the relay just trips.

e. When the PUSH TO CHECK button is released, the relay should return to the released position.

f. With the HELIX OVERCURRENT control left in the switched position at the CW limit, pressing and releasing the PUSH TO TEST button should sequentially trip and release the relay if it is adjusted properly.

g. Set the Model 650TA CATHODE switch to OPERATE. Then press the HIGH VOLTAGE RESET button.

h. Press the PUSH TO CHECK button with the HELIX OVERCURRENT control fully CW. The HIGH VOLTAGE lamp on the Model 650 panel should go off.

CAUTION

After completing the above procedures, turn the Model 650 POWER switch off and remove the ground connection between the CATH(-) tip jack and ground. Then reconnect the wire to T2-5 that was removed in paragraph 3.4.1.

3.5 USE OF THE MODEL 650TA TO CALIBRATE THE MODEL 650 (INCLUDES CHECKING CATHODE SUPPLY).

3.5.1 GENERAL. The following procedure supplements paragraph 5.3.2 (Critical Adjustments) of the Model 650 Instruction Manual. This procedure is factory-approved for adjusting the cathode supply using the Model 650TA. It also covers adjustment of A7R9 (item 6 under paragraph 5.3.3 of the Model 650 Instruction Manual), the only Periodic Recalibration Adjustment not calibrated in paragraphs 3.3 and 3.4 above.

NOTE: The Model 650TA includes an internal cathode supply dynamic load. There is no need to construct a load as was required with the earlier Model 650T unit.

CAUTION

Prior to performing the following calibration procedures, the low-voltage supplies should be checked and adjusted in accordance with paragraph 3.3 above. The following procedure is broken into sub-paragraphs for convenience, but must always be performed in its entirety and only in the sequence given. If any FREQUENCY or MARKERS potentiometer (R38, R41, R44, R46, or R48) has been replaced, or if the dial mechanism associated with any control has been repaired, the mechanical adjustment of the corresponding control(s) must be checked before proceeding with the electrical calibration procedures in the following paragraphs. Perform this mechanical adjustment in accordance with paragraph 3.6.

WARNING

In this procedure it will be necessary to remove the top and right side cover plates for access to adjustments. A block or other suitable object must be used to depress the high voltage interlock switch normally actuated by the top cover plate in the installed position. Be careful not to touch exposed high voltage circuits when the top cover is removed.

3.5.2 A1R24 BALANCE CALIBRATION. Proceed as follows:

a. Check the mechanical calibration of the F_0 control R44 in accordance with paragraph 3.6.

b. See that the Model 650TA calibration dial plate is installed on the Model 650 to be calibrated.

NOTE: The 0% calibration line is the extreme left line on the scale, and the adjacent shorter line is the 1% line. The 100% calibration line is the extreme right line on the scale, and the adjacent shorter line is the 99% line.

c. Make the following panel control settings before turning power on:

FREQUENCY Mode Selector to SINGLE
SINGLE Frequency Selector to F_0
F_0 control to the 0% line on calibration dial plate
SWEEP TRIGGER switch to MANUAL
MODULATION switch to AM OFF
HEATER LOAD switch to OPERATE
ANODE switch to 300/2 position

d. Turn the POWER switch on and let the instrument stabilize for 1/2 hour with high voltage on.

e. Connect a 0.01%, five-digit digital voltmeter to the CATH (-) test point, with the return lead to GROUND, CATH (+).

f. With the F_0 indicator set to the 0% line, the output voltage should be 150.0 V ± 1.0 V. If necessary, adjust the voltage to within this tolerance by adjusting BALANCE control A1R24. This setting should not require adjustment as the factory setting is not subject to drift. Note the exact voltage measured, for further reference.

g. Set the M_1 indicator to the 0% line and then switch the SINGLE Frequency selector to M_1. The voltage output should be within ± 1V of the voltage in step f. If the voltage is outside that tolerance, remove the dial mechanism cover plate from the front panel by removing the Phillips screw on each side. Then loosen the set screws which hold the dial cord sheave to the M_1 knob shaft. Holding the sheave so that the dial indicator remains exactly at the 0% mark, turn the M_1 control until the desired output voltage is attained. (This adjusts the M_1 pot to the proper voltage level while the indicator remains stationary.) When the proper voltage is reached, carefully tighten the set screws in the M_1 dial cord sheave.

h. Set the F_1 indicator to the 0% line, and switch the SINGLE FREQUENCY selector to F_1. The voltage output should be within ± 1V of the voltage in step f. If not, make a mechanical adjustment on the F_1 control using the procedure given in step g for the M_1 control.

3.5.3 A1R38 MAX CAL CALIBRATION. Proceed as follows:

a. Install a precision 10X or high voltage probe to drive the high voltage digital voltmeter, since voltages in the 2.5 KV range will be measured in this step. Connect the DVM probe to the CATH (-) tip jack, with the return lead to GROUND, CATH (+) tip jack.

b. Leave all controls set as at the end of paragraph 3.5.2 above, except as follows:

MANUAL SWEEP fully CW to F_2 position
SINGLE Frequency Selector to F_2
F_2 control to the 100% line on calibration dial plate
F_1 control fully counter-clockwise (left of 0% line on calibration dial plate)

c. The voltage reading should be 2500.0 V ± 3.0 V. If the voltage is outside that tolerance, adjust to the proper value using MAX CAL adjustment A1R38.

d. Recheck F_0 for 150 V ± 1V in accordance with paragraph 3.5.2 above.

e. Recheck MAX CAL adjustment A1R38 by repeating steps a through c above.

3.5.4 A7R9 SWEEP AMPLITUDE CALIBRATION. Proceed as follows:

a. Use a X1000 high voltage dc divider probe to connect the CATH (-) tip jack to the vertical input of an oscilloscope, with the return lead to GROUND, CATH (+). The oscilloscope used for this test must provide comparison voltage offset equivalent to the Tektronix Type W or Z Comparator Plug-in units used with the Tektronix 530 and 540 Series Oscilloscopes.

CAUTION

Connect the probe ground lead first. The divider probe used must be able to withstand voltages in excess of -2500 V without breakdown.

b. With all controls set as in step b of paragraph 3.5.3 above, offset the -2500 V output to obtain a reference line on the CRT. Mark this line for reference in the next steps.

c. Change the FREQUENCY Mode Selector switch setting to SWEEP $F_1 \rightarrow F_2$, and set the SWEEP TIME switch at 0.1 SEC, with the SWEEP TRIGGER switch to LINE.

d. Without changing oscilloscope control settings, note the peak sweep amplitude attained by the sweep.

e. If the sweep limit observed in step d does not coincide with the dc reference level monitored in step b, adjust A7R9 to achieve the proper sweep limit calibration.

3.5.5 R71, R72, R73, R74, and R75 INDIVIDUAL FREQUENCY CONTROL CALIBRATION. Proceed as follows:

a. Leave all controls set as at the end of paragraph 3.5.4 above, except as follows:

FREQUENCY Mode Selector to SINGLE
SINGLE Frequency Selector to F_0
F_0 control to the 1% line on the calibration dial plate
M_1 control fully counter-clockwise (left of 0% line on calibration dial plate).
M_2 control to the 1% line on the calibration dial plate.
F_1 control fully counter-clockwise.

b. Note and record the voltage reading with the SINGLE Frequency Selector at F_0.

c. Switch the SINGLE Frequency Selector to M_2 and again note the voltage reading. The M_2 voltage reading should equal the F_0 voltage reading ± 1 V. If not, remove the dial mechanism cover plate, if necessary, and loosen the set screws which hold the dial cord sheave to the M_2 knob shaft. Holding the sheave so that the dial indicator remains exactly at the 1% mark, turn the M_2 control until the voltage agrees with the reading previously obtained with the F_0 control ± 1 V. (This adjusts the M_2 pot to the proper voltage level while the indicator remains stationary.) When the proper voltage is reached, carefully tighten the set screws in the M_2 dial cord sheave.

d. Set the F_2 indicator to the 1% line on the calibration dial plate, and switch the SINGLE Frequency Selector to F_2. The voltage reading now obtained should be equal to the F_0 voltage reading ± 1V recorded in step b above. If not, adjust R71 to obtain the proper voltage calibration. (R71 is a miniature variable resistor with a blue thumb screw control, located on the "In-Voltage Calibrate" PC Board 950853 behind the Front Panel. (See Fig. 5-1 of the Model 650 Instruction Manual.)

e. Set the F_2 indicator to the 100% line on the calibration dial plate, turn the MANUAL SWEEP control fully CW to F_2, and switch the SINGLE Frequency Selector to F_2. The output voltage should be 2500 V ± 3.0 V. If the voltage is outside that tolerance range, re-adjust A1R38 to correct the indicator, and repeat paragraph 3.5.4.

f. Set the M_2 indicator to the 100% line on the calibration dial plate, and switch the SINGLE Frequency Selector to M_2. The output voltage should be the same as the voltage in step e. If not, adjust R72 (located on PC Board 950853 behind the front panel) to obtain the proper voltage calibration.

g. Set the F_0 indicator to the 100% line and switch the SINGLE Frequency Selector to F_0. The output voltage should be the same as the voltage in step e. If not, adjust R75 (located on PC Board 950853 behind the front panel) to obtain the proper voltage calibration.

h. Set the F_0 indicator to the 98% line on the calibration dial plate. Note and record the voltage reading.

i. Set the M_1 indicator to the 98% line on the calibration dial plate. Switch the SINGLE Frequency Selector to M_1 and compare the voltage reading with that obtained in step h. Again note the voltage reading. The M_1 voltage reading should equal the F_0 voltage reading ± 1 V. If not, adjust R74 (located on PC Board 950853 behind the front panel) to calibrate the M_1 voltage output.

j. Move the F_1 indicator to the 98% line on the calibration dial plate. Switch the SINGLE Frequency Selector to F_1 and again note the voltage reading. The F_1 voltage reading should equal the F_0 voltage reading ± 1V obtained in step h above. If not, adjust R73 (located on PC Board 950853 behind the front panel) to calibrate the F_1 voltage output.

3.5.6 A4R7, A4R32 and A4R55 MARKER CALIBRATION. Proceed as follows:

a. Connect a coax cable from the Model 650 MARKER OUTPUT jack to the vertical input jack of an oscilloscope. Connect a coax cable from the Model 650 OUTPUT SWEEP connector to the horizontal input jack of the oscilloscope.

b. Leave the panel controls set as at the end of paragraph 3.5.5 except as follows:

FREQUENCY Mode Selector to SWEEP F_1 - F_2
SWEEP TIME to 0.1
SWEEP TRIGGER to FREE RUN
MARKER AMPLITUDE fully CW to EXT
F_1 control to the 1% line on the calibration dial plate
Turn F_2 control fully CW
M_1 and M_2 controls to mid-scale positions.

c. Set the F_0 indicator to the 2/3% position on the calibration dial plate (2/3 the distance between the 0 and the 1% line). On the oscilloscope presentation, the marker pip should intersect the start of the sweep. If not, adjust A4R7 to achieve this condition.

d. Turn the F_0 indicator to a mid-scale position, and set the M_1 indicator to the 2/3% position on the calibration dial plate. On the oscilloscope presentation, the marker pip should intersect the start of the sweep. If not, adjust A4R32 to achieve this condition.

e. Turn the M_1 indicator to its fully CCW off-scale position, and set the M_2 indicator to the 2/3% position on the calibration dial plate. On the oscilloscope presentation, the marker pip should intersect the start of the sweep. If not, adjust A4R55 to achieve this condition.

f. Set the F_1 indicator to the 50% line on the calibration dial plate. Turn the M_1 control fully CCW and M_2 control fully CW. Adjust the F_0 indicator control until its marker pip just intersects the beginning of the sweep on the oscilloscope presentation. Then check the indicator positions on the dial plate. The F_0 indicator should be within ±1% of the F_1 indicator. If not, repeat steps b and c above, and readjust A4R7 appropriately to reduce the error observed in this step.

g. Turn the F_0 control fully CCW. With the F_1 indicator set exactly on the 50% line on the calibration dial plate, adjust the M_1 indicator control until its marker pip just intersects the beginning of the sweep on the oscilloscope presentation. Then check the indicator positions on the dial plate. The M_1 indicator should be within ± 1% of the F_1 indicator. If not, repeat steps b and d above, and readjust A4R32 appropriately to reduce the error observed in this step.

h. Turn the M_1 control fully CCW. With the F_1 indicator set exactly on the 50% line on the calibration dial plate, adjust the M_2 indicator control until its marker pip just intersects the beginning of the sweep on the oscilloscope presentation. Then check the indicator positions on the dial plate. The M_2 indicator should be within ± 1% of the F_1 indicator. If not, repeat steps b and e above, and readjust A4R55 appropriately to reduce the error observed in this step.

i. Set the F_1 indicator to the 98% line on the calibration dial plate. Repeat steps f, g, and h above to check calibration at the upper end of the dial and equalize any calibration errors between the dial extremes.

j. Turn the F_1 indicator to the 0% position, and set the F_2 indicator to the 98% line on the calibration dial plate. Repeat steps f, g, and h above, except adjust each MARKER control until its marker pip just intersects the end of the sweep on the oscilloscope presentation. The marker indicators should be within 1% of the F_2 indicator. If not, check the calibration of the sweep amplitude calibration adjustment A7R9 by repeating the procedure of paragraph 3.5.4 above. If necessary check the summing resistors at the input of each marker channel in PC Board A4.

3.5.7 MEASUREMENT OF CATHODE SUPPLY RIPPLE. Proceed as follows:

a. Leave the panel controls set as at the end of paragraph 3.5.6, except as follows:

FREQUENCY Mode Selector to SINGLE
SINGLE Selector switch to F_0
F_0 dial control knob fully counterclockwise (indicator at extreme left end of dial; <150 V dc)

b. Connect the AC COUPLED CATH (-) tip jack to the vertical input of an oscilloscope, with the ground return lead to the GROUND, CATH (+) tip jack. Also set the oscilloscope for ac coupling.

c. Monitor the ripple displayed on the oscilloscope. It should be less than 15 mv.

d. Turn the F_0 dial control fully clockwise, to move the dial indicator to the extreme right end of the dial; > 2.5 KV.

e. Monitor the ripple displayed on the oscilloscope. It should be less than 50 mv.

f. Turn the POWER switch off and disconnect test equipment.

3.6 MECHANICAL CALIBRATION OF DIAL MECHANISM.

After replacement of any FREQUENCY or MARKERS potentiometer (R38, R41, R44, R46, or R48), or if the dial mechanism associated with any control has been repaired, the mechanical adjustment of the corresponding control(s) must be calibrated before carrying out the electrical calibration procedures in paragraph 3.5 This mechanical calibration procedure supplements the instructions given in paragraph 5.6 of the Model 650 Instruction Manual. Proceed as follows:

a. Disconnect the line cord to remove all power. Then remove the top cover.

b. Label each wire to the S and CCW terminals of the potentiometer associated with the mechanism to be adjusted.

c. Unsolder the wires from the S and CCW terminals of the potentiometer. The wire to the CW terminal may be left connected.

d. Turn the corresponding control until the indicator is exactly at the 1% line on the calibration dial plate.

NOTE: When the F_2 or M_2 controls are being calibrated, turn the F_1 and M_1 controls fully counterclockwise to permit the indicator being calibrated to be positioned at the 1% line.

e. Measure the resistance between the potentiometer wiper terminal (terminal S) and the CW terminal with a sensitive ohmmeter. This resistance should be 24.0 ohms ± 0.1 ohm.

f. If the resistance is outside that tolerance, remove the dial mechanism cover plate from the front panel by removing the Phillips screw on each side. Then loosen the set screws which hold the dial cord sheave to the knob shaft of the corresponding control. Holding the sheave so that the dial indicator remains exactly at the 1% mark, turn the control until the resistance is 24.0 ohms. (This adjusts the pot to the proper position while the indicator remains stationary.) When the proper resistance is reached, carefully tighten the set screws in the dial cord sheave.

g. Reconnect and solder the wires disconnected in step c, carefully observing the labels affixed in step b.

SECTION 4

CIRCUIT DESCRIPTION

4.1 CIRCUIT DESCRIPTION. (See Schematics in Section 7.)

4.1.1 GENERAL. The Model 650TA Plug-in unit couples out all necessary instrument operating voltages from the supplies contained in the Model 650 chassis. It also provides feedback required for control of the cathode and anode voltages. Cathode voltage is adjusted by the dial controls on the Model 650 panel, and anode voltage is adjusted by controlling the feedback supplied by the plug-in unit. The maximum grid voltage excursion is provided by tapping the GRID (-) voltage directly from the drive transistor A12Q1.

4.1.2 CATHODE SUPPLY VOLTAGE OUTPUT. The cathode supply voltage output controls the rf output frequency of the tube being driven, and therefore must be calibrated accurately. To test the full range of this feedback-controlled supply, the Model 650TA allows the cathode supply output to be varied linearly from -150 V to -2500 V, and provides an internal dynamic load as described in paragraph 4.3.

The Diode Shaper PC Board A13 monitors the instantaneous output of the cathode supply through a string of feedback dropping resistors contained on PC Board A25. These resistors drop the voltage value monitored to the 0 to -15 V range, commensurate with the low-voltage control signals. Board A13 processes the low-voltage monitoring signal to develop linear feedback which corresponds to the desired linear performance curve of cathode voltage-vs-dial setting, as required to develop sufficient feedback to exactly cancel the linear 0 to +15 V voltage-determining control signal developed by the dc control circuits in the Model 650. This arrangement provides linear voltage output control with control signals that are a linear function of dial position.

4.1.3 ANODE SUPPLY VOLTAGE OUTPUT. The anode supply output level is controlled by a feedback signal developed on Elevated Supply PC Board A12 in the plug-in unit. The -100 V supply output line serves as a reference for both the anode supply and its voltage-controlling feedback circuit. The feedback signal is developed across A12R7, and is positive with respect to the -100 V supply line. Diode A12CR2 prevents the feedback signal from going more positive than the cathode supply line, which is 100 V above the -100 V supply line.

This feedback signal is tapped from the anode supply output line by A12R7 - A12R10 connected between the anode supply output line and the -100 V supply output line. The setting of the ANODE switch S3 establishes the drop between the supply output and the feedback tap.

The ANODE switch S3 is a three position switch. In the 35-volt positions it connects A12R8 in parallel with A12R9 between the anode supply output and A12R10, which provides sufficient feedback current to A12R7 to hold the anode supply at 35 V. In the 11 MA load position, S3 connects R6 to increase the supply load to 11 ma.

In the 300 V position, S3 does not connect A12R8 in parallel with A12R9, so the anode output voltage increases to 300 V to provide suitable balancing feedback current to A12R7. The screen grids of A2V1 and A2V2, in parallel with A12R11, provide a suitable 2 ma load for the anode supply during 300 V operation.

4.1.4 GRID VOLTAGE OUTPUT. The grid voltage output serves to control the rf output level in an rf-type plug-in for modulation or other purposes. To permit checking the dynamic performance of the modulator and transfer oscillator circuits in the Model 650 Chassis, an active grid modulator stage is included in the Elevated Supply PC Board A12 to simulate the one in rf-type plug-in units. The output signal level across A12R1, A12R2, and A12R3 is controlled by modulator transistor A12Q1, in response to the modulation drive signal obtained from the transfer oscillator.

For full-off modulation, a drive signal of about 38 ma is provided, producing a drop of about 95 V across A12R1 through A12R3. This output signal is connected to the GRID (-) tip jack.

4.1.5 "0 LINE" CATHODE-POTENTIAL RETURN FOR ANODE AND GRID SUPPLIES. The + anode supply and - grid supply outputs are both referenced to the 0 line which is tied to the (-) cathode supply output line within the elevated supply A12. None of these three high voltage output lines is referenced to chassis ground except through the cathode supply. The (+) terminal of the cathode supply is connected to ground within the Model 650 and at the GRD/CATH(+) black tip jack in the Model 650TA.

4.1.6 HEATER SUPPLY LOAD. The 6.3 V dc (-) heater supply output voltage is connected to the heaters of cathode load tubes A11V1 and A11V2 which provide a suitable load of ≈1.8 amps under all operating conditions.

4.1.7 HELIX OVERCURRENT CALIBRATION CIRCUIT. Since the helix output in rf-type plug-in units serves as the return path for all or a portion of the BWO tube beam current, it is important to have the helix overcurrent protection circuit properly calibrated. To simulate the helix current condition existing in an rf-type plug-in unit, a helix overcurrent network is provided in the 650TA, consisting of R2 and R3 which supply a variable current drive to A7R14 in the helix overcurrent circuit in the main chassis. Trip-out occurs when 1 ma passes through A7R14. Adjustment of the HELIX OVERCURRENT control R2 adjusts the current from the plug-in unit to A7R14 in the main chassis, with a range of about 1/2 ma to 1 ma, when PUSH TO CHECK control S2 is pressed to connect R3 to -15 V. This permits checking proper trip-out operation at the 1 ma threshold. The switched TRIP LEVEL calibration position at the clockwise limit of S5 bypasses R2 to provide exactly 1 ma output through R3.

4.1.8 HIGH VOLTAGE TURN-OFF AND HOLD-OFF PROVISIONS. The H.V. OFF pushbutton, when pressed, momentarily supplies +100 V via P6-1 to energize self-latching protection relay K3 in the Model 650 primary power circuit (Fig-

ure 4-2 of the Model 650 Instruction Manual). This relay removes power from high voltage transformer T2 until it is unlatched by pressing the HIGH VOLTAGE RESET button on the Model 650 panel. The front deck of CATHODE switch S4 also connects +100 V to P6-1 in the H.V. OFF and CALIBRATE positions to energize relay K3 and prevent turn-on of high voltage. When the CATHODE switch is turned to OPERATE, it no longer applies +100 V to K3 via P6-1, and high voltage can be turned on by pressing the HV RESET button to unlatch K3.

CAUTION

Tubes A11V1 and A11V2 in the Model 650TA provide the cathode supply load, and the heaters of both of these tubes are always turned on, so that the load tubes are always warmed up and ready for use when the OPERATE mode is selected.

4.2 DETAILED THEORY OF DIODE SHAPER BOARD A13. (See Figure 4-1.)

The diode shaper board provides linear feedback as required to produce a cathode supply output voltage proportional to control signals developed in the Model 650 that are linear with sweep time or dial position. Since the control voltage is linear, the cancelling feedback must also be developed in linear fashion.

An increase in the cathode supply voltage produces a linear, proportional feedback voltage increase as shown in Figure 4-1. Since the cathode supply circuit increases its voltage output until the control and feedback signals applied to its summing junction cancel, this means that a linear increase in control voltage drives the cathode supply output in linear fashion as shown in Figure 4-1, to produce feedback cancellation.

At the low band-edge output frequency, the cathode supply output voltage must have a value of -150 V, corresponding to the minimum shown on the dial, when the control voltage is zero. Thus, a zero feedback voltage must be developed at a specific supply output level. This is accomplished by standardizing the return voltage of A13R1 (point D) at a positive level by means of Start Freq adjustment resistor A13R26. This positive offset circuit biases point A positively so that the (-) cathode supply feedback current supplied to point A when the supply output is -150 V equals the positive offset current. This establishes a 0-volt null at point A, as required for zero feedback voltage. As the control voltage is subsequently increased above zero to + 15 V, the feedback developed at point A increases linearly from 0 to -15 V.

Amplifier stages A13Q1 and A13Q2 are cascaded emitter-follower stages that serve as an impedance converter amplifier to provide a low-impedance output at point B with the same voltage as the feedback level at point A. The point B output then serves as a suitable low-impedance source for summing junction feedback current through summing resistors A1R6 and A1R38 in the cathode supply.

The collectors of A13Q1 and A13Q2 are held close to ground level by A13CR12. Diodes A13CR13 and A13CR14 compensate for the sum of the emitter-base drops in A13Q1 and A13Q2 when these transistors are biased to heavy conduction by a 0-level feedback signal at point A, thus developing a 0-level signal at point A'. As the feedback signal increases to the -15 V level, the conduction of A13Q1 and A13Q2 decreases so that the voltage at A' tracks that at point A, but has a lower source impedance.

The End Freq adjustment resistor A13R28 provides an adjustment for the feedback current supplied from the diode shaper board to summing resistor A1R6 in the cathode supply. It is used to standardize the slope of the diode shaper board feedback by establishing the feedback level required to generate 1 ma feedback current to the summing junction at the upper band limit. This sets the maximum cathode supply voltage limit to -2500 V.

4.3 DETAILED THEORY OF CATHODE SUPPLY DYNAMIC LOAD.

Because the high voltage cathode supply should be calibrated when properly loaded, the Model 650TA provides a dynamic load consisting of tubes V1 and V2 and Load Current Adjust PC Board A1. The cathode supply voltage from the 0-line at A12-12 is connected through LOAD CURRENT ADJUST resistor A14R2 and series dropping resistor A14R1 to the cathodes of A11V1 and A11V2. The plate caps of these tubes connect to ground through A11CR1. Since high voltage is disabled by S4 except in its OPERATE position, the dynamic load serves to load the cathode supply only in the OPERATE mode. The load current drawn by the two tubes varies with cathode supply voltage in accordance with the dynamic characteristics of A11V1 and A11V2, providing 15 - 26 ma loading at all output levels. Diode A11CR1 permits measurement of load current for field calibration of the Model 650TA by measuring the current between the CATH LOAD(-) tip jack and ground, using a milliammeter to bypass A11CR1.

4.4 PROVISIONS FOR FIELD CALIBRATION OF THE MODEL 650TA.

In addition to the front panel test points described in Tables 3-1 and 3-2, four internal test points (TP1 through TP4), the LOAD CURRENT ADJUST control (A14R2), and the START and END FREQ ADJ. controls (A13R26 and A13R28) are provided.

The internal test points are located on the left-hand side of the plug-in unit near the rear. They are accessible only when the plug-in unit is removed from the Model 650 because they are used only for passive resistance checks.

The LOAD CURRENT ADJUST control is used to calibrate the dynamic load current as monitored at the CATH LOAD(-) test point. The START and END FREQ ADJ. controls are used to calibrate the A13 diode shaper feedback output developed in response to low- and high-band cathode supply voltages, as monitored between the CATH SAMPLE and DC FEEDBACK test points.

SECTION 4

CIRCUIT DESCRIPTION

4.1 CIRCUIT DESCRIPTION. (See Schematics in Section 7.)

4.1.1 GENERAL. The Model 650TA Plug-in unit couples out all necessary instrument operating voltages from the supplies contained in the Model 650 chassis. It also provides feedback required for control of the cathode and anode voltages. Cathode voltage is adjusted by the dial controls on the Model 650 panel, and anode voltage is adjusted by controlling the feedback supplied by the plug-in unit. The maximum grid voltage excursion is provided by tapping the GRID (-) voltage directly from the drive transistor A12Q1.

4.1.2 CATHODE SUPPLY VOLTAGE OUTPUT. The cathode supply voltage output controls the rf output frequency of the tube being driven, and therefore must be calibrated accurately. To test the full range of this feedback-controlled supply, the Model 650TA allows the cathode supply output to be varied linearly from -150 V to -2500 V, and provides an internal dynamic load as described in paragraph 4.3.

The Diode Shaper PC Board A13 monitors the instantaneous output of the cathode supply through a string of feedback dropping resistors contained on PC Board A25. These resistors drop the voltage value monitored to the 0 to -15 V range, commensurate with the low-voltage control signals. Board A13 processes the low-voltage monitoring signal to develop linear feedback which corresponds to the desired linear performance curve of cathode voltage-vs-dial setting, as required to develop sufficient feedback to exactly cancel the linear 0 to +15 V voltage-determining control signal developed by the dc control circuits in the Model 650. This arrangement provides linear voltage output control with control signals that are a linear function of dial position.

4.1.3 ANODE SUPPLY VOLTAGE OUTPUT. The anode supply output level is controlled by a feedback signal developed on Elevated Supply PC Board A12 in the plug-in unit. The -100 V supply output line serves as a reference for both the anode supply and its voltage-controlling feedback circuit. The feedback signal is developed across A12R7, and is positive with respect to the -100 V supply line. Diode A12CR2 prevents the feedback signal from going more positive than the cathode supply line, which is 100 V above the -100 V supply line.

This feedback signal is tapped from the anode supply output line by A12R7 - A12R10 connected between the anode supply output line and the -100 V supply output line. The setting of the ANODE switch S3 establishes the drop between the supply output and the feedback tap.

The ANODE switch S3 is a three position switch. In the 35-volt positions it connects A12R8 in parallel with A12R9 between the anode supply output and A12R10, which provides sufficient feedback current to A12R7 to hold the anode supply at 35 V. In the 11 MA load position, S3 connects R6 to increase the supply load to 11 ma.

In the 300 V position, S3 does not connect A12R8 in parallel with A12R9, so the anode output voltage increases to 300 V to provide suitable balancing feedback current to A12R7. The screen grids of A2V1 and A2V2, in parallel with A12R11, provide a suitable 2 ma load for the anode supply during 300 V operation.

4.1.4 GRID VOLTAGE OUTPUT. The grid voltage output serves to control the rf output level in an rf-type plug-in for modulation or other purposes. To permit checking the dynamic performance of the modulator and transfer oscillator circuits in the Model 650 Chassis, an active grid modulator stage is included in the Elevated Supply PC Board A12 to simulate the one in rf-type plug-in units. The output signal level across A12R1, A12R2, and A12R3 is controlled by modulator transistor A12Q1, in response to the modulation drive signal obtained from the transfer oscillator.

For full-off modulation, a drive signal of about 38 ma is provided, producing a drop of about 95 V across A12R1 through A12R3. This output signal is connected to the GRID (-) tip jack.

4.1.5 "0 LINE" CATHODE-POTENTIAL RETURN FOR ANODE AND GRID SUPPLIES. The + anode supply and - grid supply outputs are both referenced to the 0 line which is tied to the (-) cathode supply output line within the elevated supply A12. None of these three high voltage output lines is referenced to chassis ground except through the cathode supply. The (+) terminal of the cathode supply is connected to ground within the Model 650 and at the GRD/CATH(+) black tip jack in the Model 650TA.

4.1.6 HEATER SUPPLY LOAD. The 6.3 V dc (-) heater supply output voltage is connected to the heaters of cathode load tubes A11V1 and A11V2 which provide a suitable load of ≈1.8 amps under all operating conditions.

4.1.7 HELIX OVERCURRENT CALIBRATION CIRCUIT. Since the helix output in rf-type plug-in units serves as the return path for all or a portion of the BWO tube beam current, it is important to have the helix overcurrent protection circuit properly calibrated. To simulate the helix current condition existing in an rf-type plug-in unit, a helix overcurrent network is provided in the 650TA, consisting of R2 and R3 which supply a variable current drive to A7R14 in the helix overcurrent circuit in the main chassis. Trip-out occurs when 1 ma passes through A7R14. Adjustment of the HELIX OVERCURRENT control R2 adjusts the current from the plug-in unit to A7R14 in the main chassis, with a range of about 1/2 ma to 1 ma, when PUSH TO CHECK control S2 is pressed to connect R3 to -15 V. This permits checking proper trip-out operation at the 1 ma threshold. The switched TRIP LEVEL calibration position at the clockwise limit of S5 bypasses R2 to provide exactly 1 ma output through R3.

4.1.8 HIGH VOLTAGE TURN-OFF AND HOLD-OFF PROVISIONS. The H.V. OFF pushbutton, when pressed, momentarily supplies +100 V via P6-1 to energize self-latching protection relay K3 in the Model 650 primary power circuit (Fig-

ure 4-2 of the Model 650 Instruction Manual). This relay removes power from high voltage transformer T2 until it is unlatched by pressing the HIGH VOLTAGE RESET button on the Model 650 panel. The front deck of CATHODE switch S4 also connects +100 V to P6-1 in the H.V. OFF and CALIBRATE positions to energize relay K3 and prevent turn-on of high voltage. When the CATHODE switch is turned to OPERATE, it no longer applies +100 V to K3 via P6-1, and high voltage can be turned on by pressing the HV RESET button to unlatch K3.

CAUTION

Tubes A11V1 and A11V2 in the Model 650TA provide the cathode supply load, and the heaters of both of these tubes are always turned on, so that the load tubes are always warmed up and ready for use when the OPERATE mode is selected.

4.2 DETAILED THEORY OF DIODE SHAPER BOARD A13. (See Figure 4-1.)

The diode shaper board provides linear feedback as required to produce a cathode supply output voltage proportional to control signals developed in the Model 650 that are linear with sweep time or dial position. Since the control voltage is linear, the cancelling feedback must also be developed in linear fashion.

An increase in the cathode supply voltage produces a linear, proportional feedback voltage increase as shown in Figure 4-1. Since the cathode supply circuit increases its voltage output until the control and feedback signals applied to its summing junction cancel, this means that a linear increase in control voltage drives the cathode supply output in linear fashion as shown in Figure 4-1, to produce feedback cancellation.

At the low band-edge output frequency, the cathode supply output voltage must have a value of -150 V, corresponding to the minimum shown on the dial, when the control voltage is zero. Thus, a zero feedback voltage must be developed at a specific supply output level. This is accomplished by standardizing the return voltage of A13R1 (point D) at a positive level by means of Start Freq adjustment resistor A13R26. This positive offset circuit biases point A positively so that the (-) cathode supply feedback current supplied to point A when the supply output is -150 V equals the positive offset current. This establishes a 0-volt null at point A, as required for zero feedback voltage. As the control voltage is subsequently increased above zero to + 15 V, the feedback developed at point A increases linearly from 0 to -15 V.

Amplifier stages A13Q1 and A13Q2 are cascaded emitter-follower stages that serve as an impedance converter amplifier to provide a low-impedance output at point B with the same voltage as the feedback level at point A. The point B output then serves as a suitable low-impedance source for summing junction feedback current through summing resistors A1R6 and A1R38 in the cathode supply.

The collectors of A13Q1 and A13Q2 are held close to ground level by A13CR12. Diodes A13CR13 and A13CR14 compensate for the sum of the emitter-base drops in A13Q1 and A13Q2 when these transistors are biased to heavy conduction by a 0-level feedback signal at point A, thus developing a 0-level signal at point A'. As the feedback signal increases to the -15 V level, the conduction of A13Q1 and A13Q2 decreases so that the voltage at A' tracks that at point A, but has a lower source impedance.

The End Freq adjustment resistor A13R28 provides an adjustment for the feedback current supplied from the diode shaper board to summing resistor A1R6 in the cathode supply. It is used to standardize the slope of the diode shaper board feedback by establishing the feedback level required to generate 1 ma feedback current to the summing junction at the upper band limit. This sets the maximum cathode supply voltage limit to -2500 V.

4.3 DETAILED THEORY OF CATHODE SUPPLY DYNAMIC LOAD.

Because the high voltage cathode supply should be calibrated when properly loaded, the Model 650TA provides a dynamic load consisting of tubes V1 and V2 and Load Current Adjust PC Board A1. The cathode supply voltage from the 0-line at A12-12 is connected through LOAD CURRENT ADJUST resistor A14R2 and series dropping resistor A14R1 to the cathodes of A11V1 and A11V2. The plate caps of these tubes connect to ground through A11CR1. Since high voltage is disabled by S4 except in its OPERATE position, the dynamic load serves to load the cathode supply only in the OPERATE mode. The load current drawn by the two tubes varies with cathode supply voltage in accordance with the dynamic characteristics of A11V1 and A11V2, providing 15 - 26 ma loading at all output levels. Diode A11CR1 permits measurement of load current for field calibration of the Model 650TA by measuring the current between the CATH LOAD(-) tip jack and ground, using a milliammeter to bypass A11CR1.

4.4 PROVISIONS FOR FIELD CALIBRATION OF THE MODEL 650TA.

In addition to the front panel test points described in Tables 3-1 and 3-2, four internal test points (TP1 through TP4), the LOAD CURRENT ADJUST control (A14R2), and the START and END FREQ ADJ. controls (A13R26 and A13R28) are provided.

The internal test points are located on the left-hand side of the plug-in unit near the rear. They are accessible only when the plug-in unit is removed from the Model 650 because they are used only for passive resistance checks.

The LOAD CURRENT ADJUST control is used to calibrate the dynamic load current as monitored at the CATH LOAD(-) test point. The START and END FREQ ADJ. controls are used to calibrate the A13 diode shaper feedback output developed in response to low- and high-band cathode supply voltages, as monitored between the CATH SAMPLE and DC FEEDBACK test points.

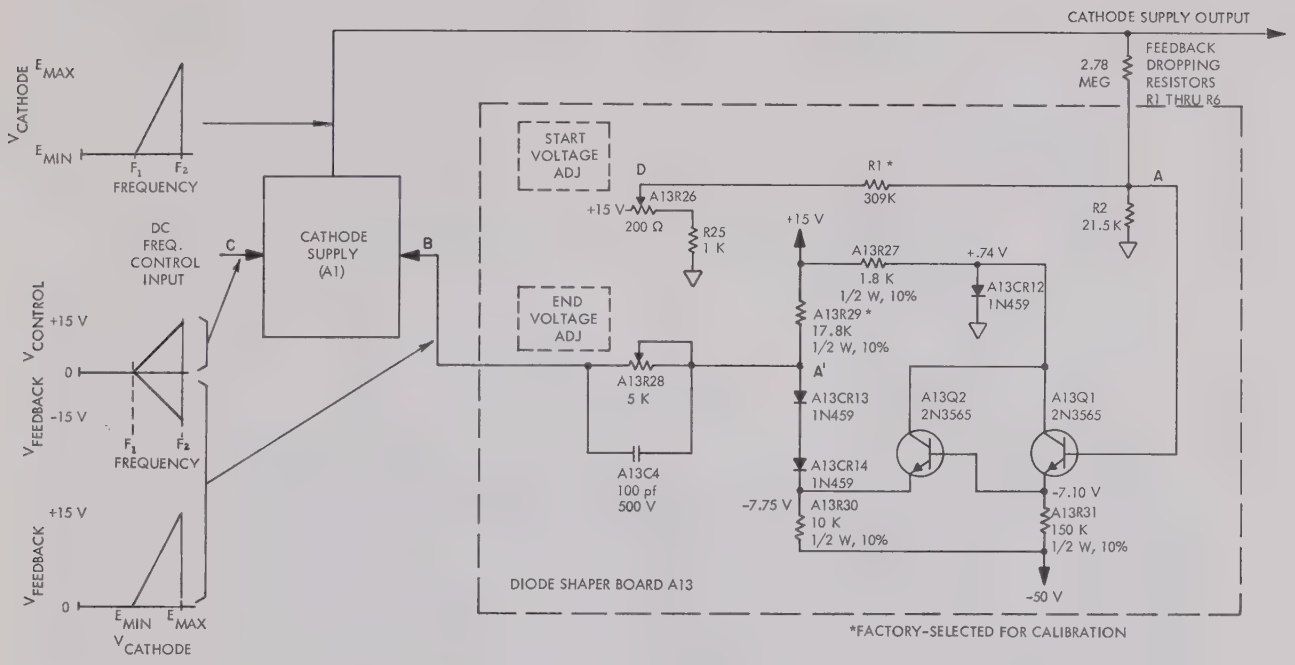


FIGURE 4-1. SIMPLIFIED SCHEMATIC OF DIODE SHAPER BOARD

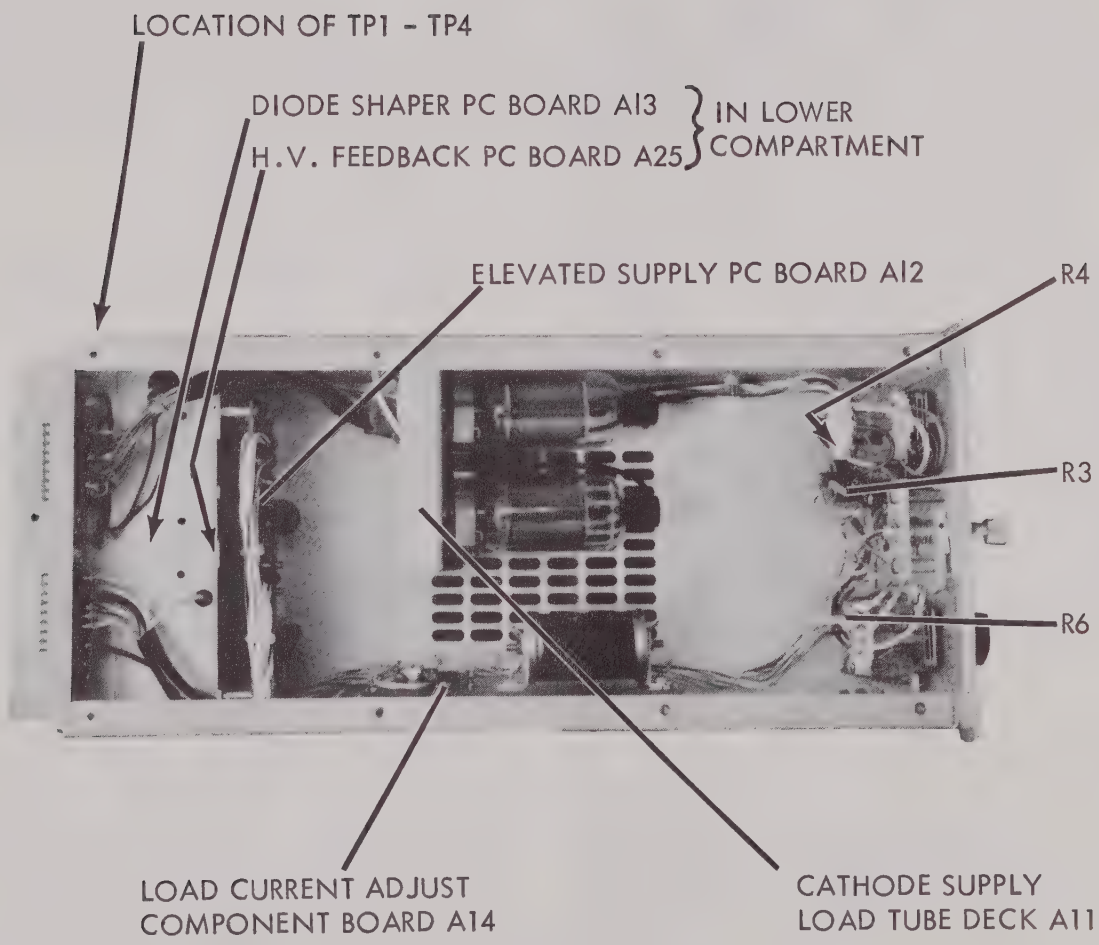


FIGURE 5-1. TOP VIEW OF MODEL 650TA WITH TOP COVER REMOVED

SECTION 5

MAINTENANCE

5.1 PERIODIC MAINTENANCE.

Every few months, perform the following maintenance on the Model 650TA.

a. Remove all accumulated dust with forced air.

b. Visually inspect the unit for loose or broken connections and loose panel controls or connectors.

5.2 FIELD CALIBRATION OF THE MODEL 650TA.

5.2.1 GENERAL. The Model 650TA is mainly a passive test fixture which provides coupling circuits and voltage divider networks to permit convenient testing of the Model 650. There are only three active circuits in the Model 650TA: The A11 dynamic load, A12 elevated supply, and A13 diode shaper. Field calibration consists of making passive resistance measurements as described in paragraph 5.2.2 and dynamic performance checks and adjustments as described in paragraphs 5.2.3 through 5.2.5. Location of adjustments and PC boards is shown in Figures 5-1 and 5-2.

5.2.2 CALIBRATION/CHECKOUT OF RESISTANCE NETWORKS. Make resistance measurements as follows, using a digital ohmmeter, with the Model 650TA removed from the Model 650.

5.2.2.1 Checkout of Heater Load Resistance (Heaters of A11V1 and A11V2). Proceed as follows:

a. Connect the ohmmeter between the HTR (-) and HTR (+) tip jacks on the front panel.

SEE MANUAL CHANGE

b. Resistance reading should be 20 Ω ± 2 Ω if the Model 650TA has not been operated for two hours. If the unit has recently been operated, so that the tube heaters are warm, resistance may decrease to 14 Ω.

c. If either resistance value is incorrect, check tubes A11V1 and A11V2 by substitution. Replace as necessary. If tubes are not defective, check for high contact resistance in the A11V1 and A11V2 sockets.

5.2.2.2 Checkout of Anode Load Resistor R6. Proceed as follows:

a. Set the ANODE VOLT/MA switch to 35/11.

OK b. Connect the ohmmeter between the ANODE (+) and ANODE (-) tip jacks.

c. Resistance should be 3.2 KΩ ± 0.3 KΩ.

5.2.2.3 Checkout of Anode Feedback Resistor Network A12R7 - A12R12. Proceed as follows:

a. Set the ANODE VOLT/MA switch to 300/2.

b. Connect the ohmmeter between the TP1 jack on the right side at the rear and the -100 V tip jack on the front panel. If ohmmeter test lead polarity is known, connect the positive lead to the -100 V tip jack. (Otherwise, lead polarity will be determined by reversing the leads in the next step.)

c. Observe the resistance reading. Unless it is known that the positive lead was connected to the -100 V tip jack in step a, reverse the ohmmeter test leads and again observe the resistance reading. The proper resistance value is 192.0 KΩ ± 2.0 KΩ. If there are two different resistance readings, this should be the higher of the two, after proper ohmmeter polarity is used to eliminate shunt paths. If the resistance value is incorrect, check A12R7.

d. For future reference, label the ohmmeter (+) lead, identified above as the lead connected to the -100 V tip jack.

e. Connect the ohmmeter (+) lead to the TP1 jack and the ohmmeter (-) lead to the TP2 jack.

f. Resistance should be 9.760 KΩ ± 98 Ω. If the resistance value is incorrect, check A12R10.

g. Connect the ohmmeter (+) lead to the ANODE (+) tip jack, with the ohmmeter (-) lead to the TP2 jack.

h. Resistance should be 296.0 KΩ ± 5.0 KΩ. If the resistance value is incorrect, check A12R9.

i. Connect the ohmmeter (+) lead to the TP4 jack, with the ohmmeter (-) lead to the TP2 jack.

j. Resistance should be 102.0 KΩ ± 1.0 KΩ. If the resistance value is incorrect, check A12R8.

k. Connect the ohmmeter (+) lead to the CATH (-) tip jack, with the ohmmeter (-) lead to the ANODE (+) tip jack.

l. Resistance should be 184.0 KΩ ± 18.0 KΩ If the resistance value is incorrect, check A12R11 and A12R12.

5.2.2.4 Checkout of Helix Overcurrent Calibration Resistors R2 and R3. Proceed as follows:

a. Connect the ohmmeter between the -15V tip jack and the TP3 jack on the right side at the rear.

b. Rotate the HELIX OVERCURRENT control fully clockwise to its switched position.

c. Press the PUSH TO CHECK button and note the resistance reading. It should be 15 KΩ ± 150 Ω. If the resistance value is incorrect, check R3.

d. Rotate the HELIX OVERCURRENT CONTROL fully counterclockwise.

e. Press the PUSH TO CHECK button and note the resistance reading. It should be 25 KΩ ± 2.65 KΩ. If the resistance value is incorrect, check R2.

5.2.2.5 Checkout of Leveler Reference Monitoring Resistor R1. Proceed as follows:

a. Connect the ohmmeter between the LEV REF and GROUND, CATH (+) tip jacks.

b. Resistance should be 332 Ω ± 3 Ω. If the resistance value is incorrect, check R1.

5.2.2.6 Checkout of High Voltage Feedback Resistor PC Board A25. Proceed as follows:

a. Set the CATHODE switch to OPERATE.

b. Connect the ohmmeter (+) lead to the CATH (-) tip jack and the ohmmeter (-) lead to the front panel CATH SAMPLE jack.

c. Resistance should be 2.784 megohms ± 278 KΩ. If the resistance value is incorrect, check resistors A25R1 through A25R6. Also check capacitor A25C1 for excessive leakage.

5.2.2.7 Checkout of Elevated Supply Resistors A12R1-A12R6 in Grid Driver Circuit. Proceed as follows:

a. Set the ANODE VOLT/MA switch to 35/0.

b. Connect the ohmmeter (+) lead to the CATH (-) tip jack and the ohmmeter (-) lead to the GRID (-) tip jack.

c. Resistance should be 2.26 KΩ ± 100 KΩ. If the resistance value is incorrect, check resistors A12R1 through A12R3, coil A12L1, and capacitor A12C1.

e. Resistance should be 19.8 KΩ ± 2 KΩ. If the resistance value is incorrect, check resistors A12R4 through A12R6.

5.2.2.8 Checkout of DC Feedback Calibration Resistor R4. Proceed as follows:

a. Remove the Diode Shaper PC board A13.

b. Turn the CATHODE switch to CALIBRATE.

c. Connect the ohmmeter between the DC FEEDBACK and GROUND / CATH (+) tip jacks.

d. Resistance should be 15K Ω ±150 Ω. If the resistance is incorrect, check R4 and S4.

e. Insert the Diode Shaper PC board A13.

5.2.3 CALIBRATION/CHECKOUT OF DIODE SHAPER PC BOARD A13. Proceed as follows:

a. Install the Model 650TA Calibration Plug-in Unit into a Model 650 in good working condition. This Model 650 will be used only to supply working power supply voltages to the Model 650TA being calibrated. Its low voltage supplies should be calibrated in accordance with paragraph 3.3, but its high voltage supplies and cathode supply need not be calibrated.

b. Before turning the Model 650 POWER switch ON, turn the Model 650TA CATHODE switch to CALIBRATE.

c. Make the following Model 650 panel control settings before turning power on:

FREQUENCY Mode Selector to SINGLE
SINGLE Frequency Selector to F_0
F_0 control fully counter-clockwise
MODULATION switch to AM OFF
SWEEP TRIGGER switch to MANUAL

d. Turn the POWER switch on and let the instrument stabilize for 1/2 hour.

e. Obtain a Laboratory Power Supply which can provide -150V and -2500V with a load current of <2 ma. A suitable source is the (-) cathode supply output of another Model 650 containing the Model 650 P1 Power Supply Plug-in unit or another Model 650TA Calibration/ Maintenance Plug-in unit. These units need not be calibrated since a digital voltmeter will be used to monitor the exact -150V or -2500V supplied (and permit adjustment if necessary).

f. Set the Laboratory Power Supply to provide ≈ -150V dc output.
NOTE: If a Model 650/650 P1 or 650TA is used, make control settings as in steps c and d but with high voltage on.

g. Connect a 0.1%, five-digit, high voltage (0 to > 3KV) voltmeter to the - output of the Laboratory Power Supply, with the return lead to ground.

h. Adjust the Laboratory Power Supply controls to provide 150.0V.
NOTE: If a Model 650 is used, adjust the F_0 control slightly to achieve this voltage.

i. Connect the Laboratory Power Supply output to the CALIBRATION VOLTAGE IN jack on the front panel of the Model 650TA being calibrated, and note that the voltage does not change.

j. Connect a 0.01%, five-digit low voltage dc digital voltmeter to the CATH SAMPLE jack on the front panel of the 650TA being calibrated, with the return lead to the GROUND / CATH (+) jack.

k. The voltage measured at the CATH SAMPLE jack should be -170 mv ±6 mv. If it is not within this range, adjust the Start Voltage control A13R26 on the Diode Shaper PC Board A13 of the Model 650TA under test.

A13R26 is accessible through an opening in the left-hand side of the Model 650 containing the Model 650TA, when its left handle side is removed.

NOTE: If A13R26 does not provide sufficient adjustment range, change A13R1 to correct it. Increasing the value of A13R1 tends to make the (-) CATH SAMPLE voltage increase in magnitude.

l. Connect the 0.01%, five-digit low voltage dc digital voltmeter to the DC FEEDBACK jack on the front panel of the Model 650TA being calibrated. Leave the return lead connected to the GROUND/CATH (+) jack.

m. Turn the Stop Voltage 20-turn screwdriver adjust control A13R28 fully clockwise and then back it off exactly 10 turns to center its wiper. A13R28 is accessible through openings in the left hand side of the Model 650 and Model 650TA when the Model 650 left handle side is removed.

n. With A13R28 centered, the voltage at the DC FEEDBACK jack should be -170 mv ±6 mv, to verify proper unity gain of the feedback amplifier. If the voltage is correct, proceed to step aa. If the voltage is not correct, follow steps o through z to select a new value of A13R29 to correct the voltage without changing A13R28 from its centered condition.

o. Turn off the Laboratory Power Supply.

p. Turn off the Model 650 containing the Model 650TA.

q. Remove the PC board retainer for Diode Shaper PC Board A13 on the left side of the Model 650TA chassis, near the rear.

r. Unplug and remove Diode Shaper PC Board A13.

s. Remove resistor A13R29 from the PC board.

t. Connect a resistor substitution box in place of A13R1, using appropriate, insulated interconnecting leads to permit the PC board to be reinserted in its operating position. Set the resistor box to the resistance of the removed resistor A13R29.

u. Replace the Diode Shaper PC Board A13 into the Model 650TA, ensuring that the resistor board interconnecting wires do not touch the High Voltage Feedback Board A25 at the front of the opening.

v. Turn on the Model 650 and the Laboratory Power Supply.

w. With 150.0V ±2.0V still applied to the CALIBRATION VOLTAGE IN jack as established in steps h and i above, adjust the resistor box to obtain a voltage of -170 mv ±6 mv at the DC FEEDBACK jack. Note this proper resistance value.

x. Repeat steps o through r to remove the Diode Shaper PC Board A13. Then disconnect the resistor box and install in the A13R29 position a resistor of the value selected in step w.

y. Replace the Diode Shaper PC Board A13 into Model 650TA and install its PC board retainer.

z. Turn on the Model 650 and the Laboratory Power Supply.

aa. Adjust the Laboratory Power Supply controls to provide 2500.0V ±2.0V.
NOTE: If a Model 650 is used, turn the F_0 control to the right-hand end of the dial and set to this exact voltage.

bb. The voltage measured at the DC FEEDBACK jack (with the voltmeter still connected as in step l) should be 14.60V ±0.05V.

cc. If the voltage measured in step bb is outside the specified range, adjust A13R28 slightly to correct it. Then repeat steps h through l and aa and bb to correct for any interaction of adjustments.

5.2.4 CALIBRATION/CHECKOUT OF ELECTRONIC CATHODE LOAD Contained in PC Boards A11 and A14.

a. Install the Model 650TA Calibration Plug-in Unit into a Model 650 in good working condition. This Model 650 will be used only to provide working voltages (both low and high voltages) to the Model 650TA. These voltages need not be precisely calibrated.

NOTE: See that the Model 650TA calibration dial plate is installed on the Model 650 to be used.

b. Make the following panel control settings before turning power on:

FREQUENCY Mode Selector to SINGLE
SINGLE Frequency Selector to F_0
F_0 control to the 100% line on the calibration dial plate
MODULATION switch to AM OFF
SWEEP TRIGGER switch to MANUAL
CATHODE switch to OPERATE
ANODE switch to 300/2 position

c. Turn the POWER switch on and let the instrument stabilize for 10 minutes with high voltage on.

d. If a 0 - 50 ma milliammeter is available, connect its (+) lead to the GROUND, CATH(+) tip jack, and the milliammeter (-) lead to the CATHODE LOAD (-)tip jack. If a milliammeter is not available, connect a jumper between the GROUND, CATH (+) and CATH (-) tip jacks and connect a clip-on millammeter probe to the jumper wire to measure the load current in the wire.

e. The load current as read on the milliammeter should be 26 ma ±1 ma. If the load current is incorrect, adjust LOAD CURRENT ADJUST control to obtain 26 ma. If this adjustment will not produce the required voltage, turn off power and install new tubes A11V1 and A11V2 to check the performance of the original tubes by substitution. If tube substitution does not solve the trouble, check A11CR1, A11R2, A14R1, and A14R2.

NOTE: The LOAD CURRENT ADJUST control A14R2 can be adjusted by turning the slotted plastic shaft which is flush with the left-hand side of the Model 650TA, near the center of the side. Access to this insulated shaft is through an opening in the left-hand side of the Model 650 when its left handle side is removed. The value of fixed, factory select resistor A14R1 may have to be changed as tubes age or if tube replacement is required, to restore the proper adjustment range of A14R2.

5.2.5 CHECKOUT OF GRID DRIVER CIRCUIT IN ELEVATED SUPPLY PC BOARD A12. Proceed as follows:

a. Install the Model 650TA Calibration Plug-in Unit into a Model 650 in good working condition.

NOTE: See that the Model 650TA calibration dial plate is installed on the Model 650 to be used.

b. Disable the Model 650 cathode supply in accordance with paragraph 3.4.1 of this manual.

c. Make the following panel control settings before turning power on:

FREQUENCY Mode Selector to SINGLE
SINGLE Frequency Selector to F_0
F_0 control to the 0% line on calibration dial plate
MODULATION switch to AM OFF
SWEEP TRIGGER switch to MANUAL
CATHODE switch to OPERATE
ANODE switch to 35/11 position

d. Connect a lead from the 100V (-) tip jack to a digital voltmeter, with the voltmeter ground return lead to the 100V (+) tip jack.

e. Turn the POWER switch on and let the instrument stabilize for 10 minutes with high voltage on.

f. The voltage should be -100 V ± 0.1 V. If the voltage is incorrect, the -100 V supply of the Model 650 in use should be calibrated by adjusting A6R5 in accordance with paragraph 3.4.2 of this manual.

g. Press the HV OFF button to remove high voltage.

h. Remove the Model 650 top cover for access to the TRANSFER OSCILLATOR OUTPUT test point A9TP12 which is accessible through an opening in the top of the transfer oscillator shield housing at the front, left corner of the instrument.

WARNING

High voltages are exposed when the top cover is removed. An insulated block or other suitable object must be used to depress the high voltage interlock switch normally actuated by the top cover plate in the installed position. Be careful not to touch exposed high voltage circuits when the top cover is removed.

i. Connect a lead from the TRANSFER OSCILLATOR OUTPUT test point A9TP12 to the digital voltmeter. The voltmeter ground return lead may remain connected to the 100V (+) tip jack.

j. Having placed a block on the Model 650 top cover interlock switch in accordance with the WARNING in step h, above, press the HV RESET button to restore high voltage.

k. With the MODULATION switch in AM OFF, the voltage should be -100 V ± 1 V.

l. Turn the MODULATION switch to AM EXT.

m. The voltage should be -95 V ± 1 V.

NOTE: If the voltage is incorrect in either step k or m, there is a defect in either the Model 650 transfer oscillator A9 or the Model 650TA elevated supply A12. The problem can be localized by making the same measurement with an rf-type plug-in unit installed. For such a measurement, the 0 LINE test point TP10 should be jumpered to chassis ground and the voltmeter return lead should be connected to chassis ground.

n. Press the HV OFF button to remove high voltage.

o. Connect a lead from the GRID (-) tip jack to the digital voltmeter. The voltmeter return lead may remain connected to the 100V (+) tip jack.

p. Press the RESET button to restore high voltage.

q. Note the voltage reading with the MODULATION switch in the AM EXT position. Then turn the MODULATION switch to AM OFF and again note the voltage. Switch back and forth between positions twice and note the voltage in each case. The voltage with the MODULATION switch in AM OFF must be less than 0.3 volt. The voltage with the MODULATION switch in AM EXT must be 95V ±5V. If the voltage is incorrect, remove power and check transistor A12Q1 and associated components.

r. Turn off power and disconnect all test equipment.

CAUTION

After completing the above procedure, remove the ground connection between the CATH(-) tip jack and ground. Then reconnect the wire to T2-5 that was removed per paragraph 3.4.1 Then replace the Model 650 top cover.

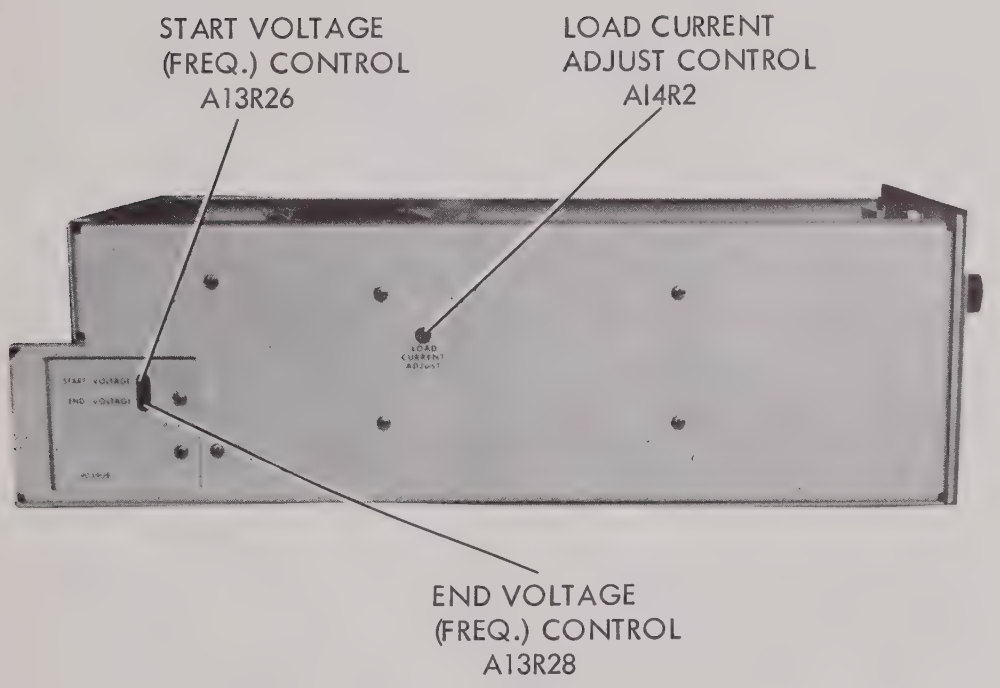
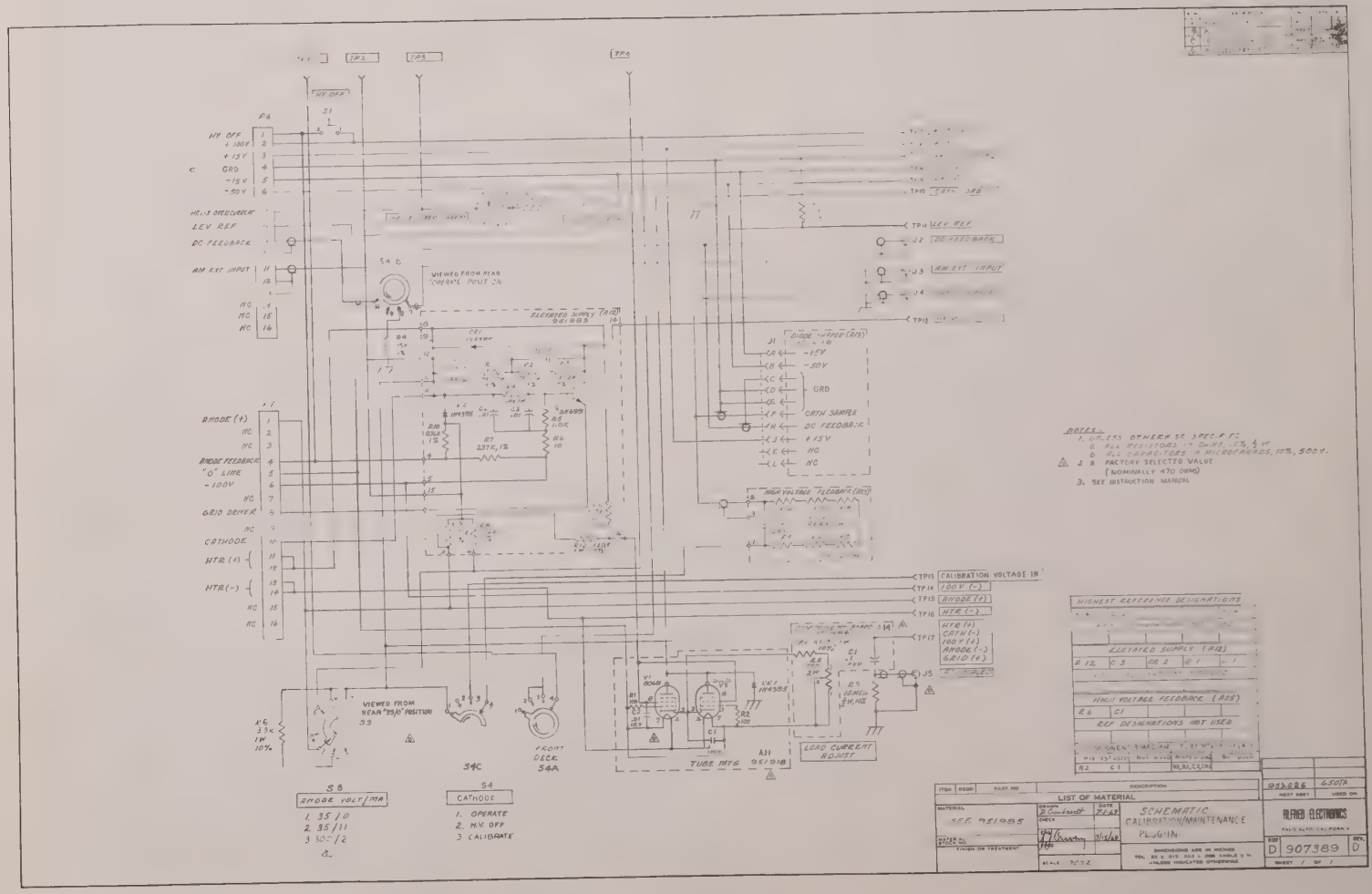


FIGURE 5-2. LEFT SIDE VIEW OF MODEL 650TA


TP2
TP3
TP9
CUT OFF
S1
P6
HV OFF
+ 100V
+ 15V
GRD
- 15V
- 50V
HEATER CHECK/ART
LEV REF
DC FEEDBACK
AM EXT INPUT
NC
NC
NC
S4 B
VIEWED FROM REAR
OPERATE POSITION
ELEVATED SUPPLY (A12)
981983
CR1
1N4999
R4
R5
R6
1.0K
R7
237Ω, 1%
R8
R9
R10
100Ω
1%
1N4585
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
C13
C14
C15
C16
C17
C18
C19
C20
C21
C22
C23
C24
C25
C26
C27
C28
C29
C30
C31
C32
C33
C34
C35
C36
C37
C38
C39
C40

SYM	DESCRIPTION	NO	DATE	BY
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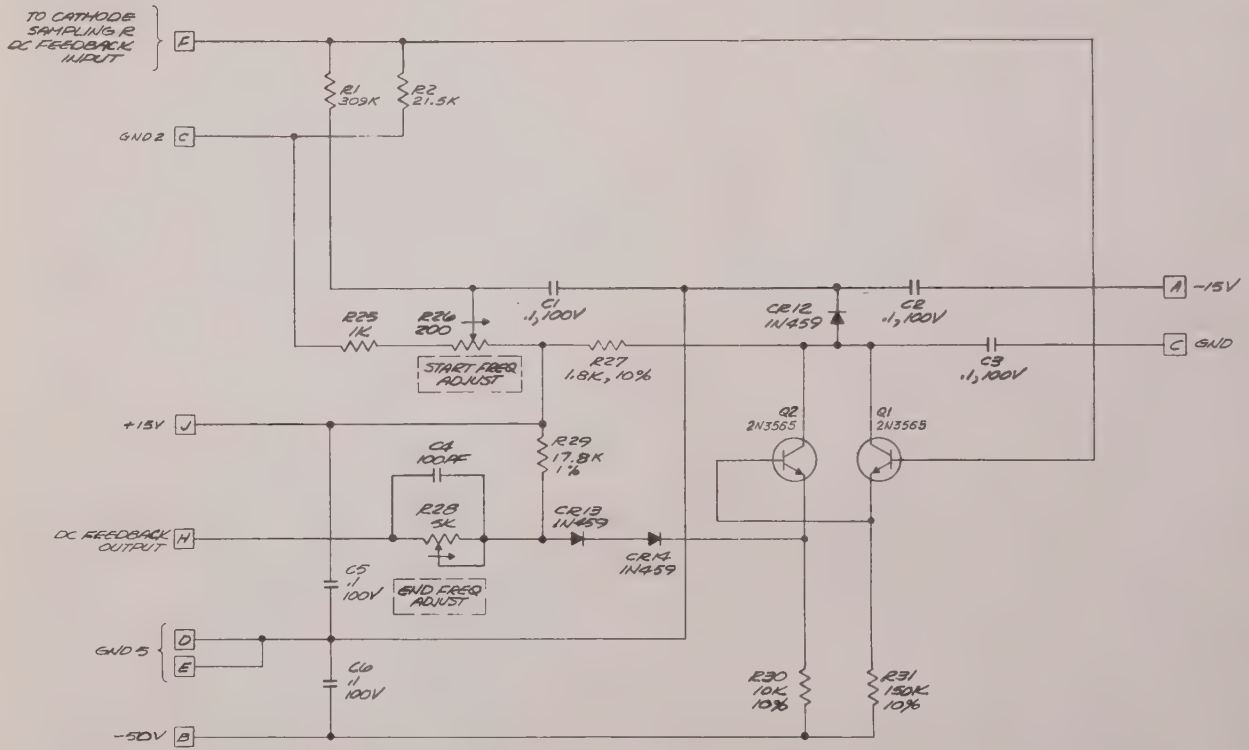

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   1A. ALL RESISTORS IN OHMS, ½W, 1% METAL FILM
   1B. ALL CAPACITORS IN MICROFARADS
2. SQUARES (□) DESIGNATE PRINTED CIRCUIT CONNECTION ON ASSY NO. 901298
3. PREFIX REFERENCE DESIGNATORS BY "A13" (I.E: A13R1, A13Q2)

ITEM	REQD	PART NO	DESCRIPTION	S/N 11-UP	050T
			LIST OF MATERIAL	NEXT ASSY	USED ON

MATERIAL

MATERIAL STOCK NO

FINISH OR TREATMENT

DRAWN A. Starr 11-6-64

END. [signature] 12-8-65

PROD. N. Leland 1-11-65

SCALE

SCHEMATIC
DIODE SHAPER
(150 - 2500V LINEAR)

DIMENSIONS ARE IN INCHES
TOL .XX ± .015, .XXX ± .005 ANGLE ± ½
UNLESS INDICATED OTHERWISE

ALFRED ELECTRONICS
PALO ALTO CALIFORNIA

900837C

SHEET 1 OF 1

FEDERAL SUPPLY CODE FOR TRUE MANUFACTURERS

FMC NO.	Full Name and Address of Vendor
00656	Aerovox Corporation, 740 Belleville Ave., New Bedford, Mass.
00686	Film Capacitors, Inc., 100 East 8th Street, Passaic, N.J.
00816	Hughes Aircraft Co., Vacuum Div., 500 Superior Avenue., Newport Beach, Calif.
00853	Sangamo Electric Co., P. O. Box 128, Pickens, S. C.
00866	Goe Engineering Co., 219-21 S. Mednik Ave., Los Angeles, Calif.
00929	Microlab/FXR, 10 Microlab Rd., Livingston, N. J.
01121	Allen Bradley Co., 136 W. Greenfield Ave., Milwaukee, Wisc.
01281	Pacific Semiconductor Co., 10451 W. Jefferson Blvd, Culver City, Calif.
01456	Microwave Development Laboratories, 87 Crescent Road, Needham Heights, Mass.
01963	Cherry Electrical Products Corp., Box 439, Highland Park, Ill.
02111	Spectrol Electric Corporation, 17070 E. Gale Ave., City of Industry, Calif. 91745
02114	Ferroxcube Corporation of America, Mt. Marian Rd., Saugerties, N. Y. 12477
02116	Wheelock Signals Inc., 273 Branchport Ave., Long Branch, N.J. 07440
02735	Radio Corp. Solid State & Tube Div., Route 202, Somerville, N. J.
03508	G. E. Semiconductors, Electronics Park, Syracuse, N.Y. 13201
03565	Dayton Electronic Products Co., 117 E. Helena St. Dayton, Ohio
03782	Singer Co., Alfred Operation, 3176 Porter Drive, Palo Alto, Calif. 94304
04009	Arrow-Hart, & Hegeman Elec. Co., 113 Hawthorne St., Hartford, Conn.
04713	Motorola Semiconductor Products, Inc., P. O. Box 955, Phoenix, Arizona
04773	Automatic Electric Co., Wolf Rd., Northlake, Ill. 60164
05063	Avnet Electronic Supply Co., Westbury, New York 11590
05783	Stewart Engineering Co., 467 Bean Creek Rd., Santa Cruz, Calif.
05820	Wakefield Engineering, Inc., 139-T Foundry St., Wakefield, Mass.
06049	Topaz, 3802 Houston, San Diego, Calif. 92110
06509	Gulton Ind., Inc., Instr. Prod. Div. West, 13030 Cerise Ave., Hawthorne, Calif. 90250
06555	Beede Electrical Instrument Co., Inc., Penacock, N. H.
06980	Varian, 611 Hansen Way, Palo Alto, Calif. (BWO)
07137	Transistor Electronics Corp., Box 6191, Minneapolis, Minn.
07263	Fairchild Semiconductor, 545 Whisman Rd., Box 880, Mountain View, Calif.
08806	General Electric Corp., Min. Lamp Dept., Nela Park, Cleveland, Ohio
09022	Comell-Dubilier, 50 Paris St., Newark, N.J. (Mica Caps)
09023	Comell-Dubilier, 50 Paris St., Newark, N. J. (Electrolytic Caps)
09297	CP Electronics, Inc., Columbus, Ind.
11312	Microwave Electronics Div. of Teledyne, 3165 Porter Drive, Palo Alto, Calif.
11870	Melabs, Inc., 3300 Hillview, Palo Alto, Calif. 94304
12060	Diodes, Inc., 9261 Independence Ave., Chatsworth, Calif.
12122	Astrodyne, Inc., 2nd Ave., NW. Ind. Park, Burlington, Mass. 01803
12360	Albany Products, 351 Connecticut Ave., South Norwalk, Conn.
12598	RLC Electronics, Inc., 25 Martin Pl., Port Chester, N. Y. 10573
12697	Clarostat Mfg. Co., Washington St., Dover, N.H.
13175	Electro-Mechanical Corp., 701 S. Elmer Ave., Sayre, Pa. 18840
13664	Workman Elec. Prod. Inc., Packing House Rd., Sarasota, Fla. 33578
13862	Alasco Rubber & Plastic Corp., 839 Malcom Rd., Burlingame, Calif.
14026	Spatron, Inc., 715 S. Raymond Ave., Alhambra, Calif. 91803
14433	International Telephone & Telegraph, 3301 Electronic Way, W. Palm Beach, Florida
14482	Watkins-Johnson Co., 3333 Hillview, Palo Alto, Calif
14551	Wesco Electronics, Los Angeles, Calif.
15582	Bay City Screw & Bolt Co., 601 Industrial Way, San Carlos,. Calif.
15818	Amelco, 1300 Terra Bella, Mt. View, Calif. 94042
16299	Corning Glass Works, Electronic Products Div., 3906 Electronics Dr., Raleigh, N.C.
16741	Triad Dist. Div. (Litton Ind.) 305 N. Briant St., Huntington, Ind.
17474	Tranex, Inc., 1599 Stierlin Rd., Mountain View, Calif.
17545	Atlantic Semiconductors, Inc., 905 Mattison Ave., Asburg Park, N. J. 07712
17920	Warnecke Electron Tubes, 175 W. Oakton St., Des Plaines, Ill.
18489	Reliable Capacitors Co., 14716 Arminta St., Van Nuys, Calif.
18741	High Vacuum Electronics, Inc., 538 Mission St., South Pasadena, Calif. 91030
18915	Birtcher Corp., The Industrial Div., 745 S. Monterey Pass Rd., Monterey Park, Calif.
19701	Electra Mfg. Co., 800 North 21st., Independence, Kansas
20286	Daytron, Inc., 1269 Terra Bella, Mountain View, Calif
20649	Universal Metal Products, 5924 N. Western Ave., Chicago 45, Ill.
21030	Beckman Instrument Inc., Helipot Div., 2500 Harbor Blvd., Fullerton, Calif.
21743	Canseat Corp., 4164 Greenbush Ave., Sherman Oaks, Calif.
22229	Union Carbide, Kemet Elect. Div., Mountain View, Calif.
23095	Aztec Electronics, Inc., 163 Liberty Ave., Anaheim, Calif.
23585	Hunter Associates Laboratory, Inc., 9529 Lee Highway, Fairfax, Va. 22030
23880	Stanford Applied Engineering, 340 Martin Ave., Santa Clara, Calif. 95050
24220	Gowanda, 179 Broadway Rd., Gowanda, N.Y.
24796	Parelco, Inc., 26181 Avenida Aeropuerto, San Juan Capistrano, Calif. 92675
24931	Spec. Connector Co., 3560 Madison Ave., Indianapolis, Ind., 46227
26769	National Capacitors, Inc., (NCI), 5900 Voss Rd., W. Palm Beach, Fla. 33407
27014	National Semi-Conductor Corp., 2950 San Ysidro Way, Santa Clara, Calif.
28480	Hewlett-Packard, Paeco Div., 3215 Porter Drive, Palo Alto, Calif. 94304
29083	Monsanto Co., Inc., 2710 Lafayette, Santa Clara, Calif. 95050
31870	Viking Electronics, Inc., 721 St. Croix, Hudson, Wisconsin 54016
31918	International Electronics Exchange, 6529 Cambridge St., Minneapolis, Minn. 55426
32293	Intersil, Inc., 10900 N. Tantau Ave., Cupertino, Calif. 95014
33173	General Electric Corporation, Tube Dept., 316 E. Ninth St., Owensboro, Ky.
35434	Lectrohm, Inc., 5560 Northwest Hwy., Chicago, Ill.
37942	Mallory Capacitor Co., Div. P. R. Mallory & Co., Inc., 3029 E. Washington St., Indianapolis, Ind.
42190	The Muter Co., 1255 S. Michigan Ave., Chicago 5, Ill.
42498	National Radio Co., 111 Washington St., Melrose, Mass., 02176
43543	Nytronics, Inc., Transformer Co. Div., 3rd Avenue, Alpha, N.J. 08866
44655	Ohmite Mfg. Co., 3635 W. Howard St., Skokie, Ill.
46384	Penn Engineering, West State St., Doylestown, Penn.
56289	Sprague Electric Co., 91 Marshall St., N. Adams, Mass.
59730	Tyrap, C/O Thomas & Betts Co., 645 Phelps St., San Francisco, Calif.
70309	Allied Control Co., 2 East End Ave., New York, N.Y.
70318	Allmetal Screw Products Co., Inc., 821 Stewart Ave., Garden City, N.Y.
70563	Amperite Co., Inc., 600 Palisade Ave., New Jersey
70903	Belden Mfg. Co., Box 5070-A, Chicago, Ill. 60644
71436	Chicago Condenser Corporation, 3253 Armitage Ave., Chicago, Ill. 60647
71450	CTS Corp., 1172 W. Beardsley, Elkhart, Ind.
71590	Centralab, Electronics Div., Globe Union, 934 Keefe Ave., Milwaukee, Wisc.
71707	Cato Coil Co., Inc., Box B, Edgewood Station, Providence, R.I.
71785	Cinch Mfg. Co., 1026 S. Homan Ave., Chicago 24, Ill.
71895	Delavan Mfg. Co., Electro-Sonics Div., West Des Moines, Iowa
72012	M. Ducommun Mfg. Co., 580 Fifth Ave., New York, N.Y. 90036
72136	Electro Motive Mfg. Co., Inc., S. Park & John Streets, Willimantic, Conn. 06226
72765	Drake Mfg. Co., 4626 N. Olcott Ave., Harwood Heights, N.Y. 60656
72982	Erie Technological Products, Inc., 644 W. 12th St., Erie, Penn.
72983	Stancor Electronics (Essex Wire Corp.)3501 W. Addison St., Chicago, Ill.
73293	Hughes Aircraft Co., Elec. Comp., Div., 500 Superior Ave., Newport Beach, Calif.
73445	Amperex Electronic Corporation, Box 418, 230 Duffy Ave., Hicksville, N.Y.
73559	Carling Electric Inc., 505 New Park Ave., West Hartford, Conn. 06110
73899	JFD Elect. Co., Comp. Div., 15th Ave. at 62nd St., Brooklyn, N.Y.
74542	Hoyt Electrical Inst. Works, Inc., 42 Carleston St., Cambridge, Mass.
74868	Amphenol Corp., Connector Div., 1830 S. 54th Ave., Chicago, Ill.
74970	The E. F. Johnson Co., 1923 10th Ave., S.W. Waseca, Minn.
75376	Kurz Kasch, 1417 S. Broadway, Dayton, Ohio
75382	Kulka Electric Corp., 520 S. Fulton Ave., Mt. Vernon, N.Y.
75042	IRC, Inc., 401 N. Broad St., Philadelphia, Penn.
75497	Lamson & Sessions, 5002 Tiedeman Rd., Cleveland, Ohio
75915	Littlefuse, Inc., 800 E. Northwest Hwy., Des Plaines, Ill.
76433	General Instrument Corp., 65 Gouverneur, Newark, N.J.
76487	James Millen Mfg. Co., Inc., 150 Exchange St., Malden, Mass. 02148
76854	Oak Mfg. Co., S. Main Street, Crystal Lake, Ill. 60014
77342	Potter & Broomfield, Div. of American Machine & Foundry Co., 1200 E. Broadway, Princeton, Indiana
77557	Reliable Spring & Wire Forms Co., 3167 Fulton Rd., Cleveland, Ohio
78553	Tinnerman Co., Dept. 16-T, P. O. Box 6688, Cleveland, Ohio
78947	Ucinite Corporation, 459 Watertown St., Newtonville, Mass. 02160
79493	J. W. Miller Co., 5915 S. Main St., Los Angeles, Calif. 90003
80294	Bourns, Inc., 1200 Columbia Ave., Riverside, Calif. 92507
81073	Grayhill, Inc., 569 Hillgrove Ave., La Grange, Ill.
81312	Winchester Electronics, Inc., Div. Litton Industries, 19 Willard Rd., Norwalk, Conn.
82219	Sylvania Electric Prod., Revg. Tube Div., Emporium, Pa.
82389	Switchcraft, Inc. 5555 N. Elston Ave., Chicago 30, Ill.
83186	Victory Engineering, 128 Springfield Ave., Springfield, N. J.
83701	Electronic Devices Inc., 21 Grey Oaks Ave., Yonkers, N.Y.
84411	TRW Capacitor Div., 112 West First Street, Ogallala, Nebraska
86684	Radio Corp. of America, Electronic Components & Devices, 415 S. 5th St., Harrison, N.J.
88245	USECO, Div. of Litton Industries, 13536 Saticoy St., Van Nuys, Calif.
89110	AMP, Inc., 155 Park St., Elizabethtown, Penn.
89536	John Fluke Mfg. Co., Inc., P. O. Box 7428, Seattle, Wash.
91278	Stoesser Tool & Die, 3366 Fayette Dr., Mountain View, Calif.
91418	Radio Materials Co., 4242 W. Bryn Mawr Ave., Chicago 46, Ill.
91637	Dale Electronics,Inc., (Subs. Lionel Corp.) Box 609, 1342 28th Street., Columbus, Nebr.
91737	Gremar Mfg. Co., Wakefield, Mass.
91755	Harrison & Bonini, 1122 Harrison St., San Francisco, Calif.
91827	K & F Tool Die & Mfg., Inc., 1203 Dell Ave., Campbell, Calif.
92219	Waldom Electronics, Inc., 4625 W. 53rd St., Chicago, see 60632.
93332	Sylvania Electric Products, Inc., Semiconductor Div., 100 Sylvan Rd., Woburn, Mass.
93389	Prota Stamping, Washington & Santa Fe, Los Angeles 54, Calif.
94144	Raytheon, 465 Centre St., Quincy, Mass. 02164
94375	Automatic Metal Products Corp., 323 Berry St., Brooklyn 11, N.Y.
94696	Magnecraft Electric Co., 5579 N. Lynch Rd., Chicago, Ill. 60630
95263	Leecraft Mfg. Co., Inc., 21-16 44th Rd., Long Island City, N.Y. 11101
95348	Gordos Corp., 250 Glenwood Ave., Bloomfield, N.J. 07003
95354	Methode Electronics, Inc., 7447 W. Wilson Ave., Chicago, Ill.
95712	Bendix Corp., Microwave Devices Div., (Dage), Franklin, Ind.
95987	Weckesser Co. Inc., 4444 W. Irving Park, Chicago, Ill.
96214	Texas Instruments, Inc., Semiconductor-Components Div., Box 5012, Dallas, Texas
96791	Bunker-Ramo Corp., Amphenol Industrial Div., Janesville, Wisc.
97464	Industrial Retaining Ring Co., 57 Cordier St., Irvington, N.J.
98003	Neilson Hardware Corp., 770 Weathersfield Ave., Hartford, Conn.
99120	Plastic Capacitors, Inc., 2620 N. Clybourn Ave., Chicago, Ill.
99313	Varian, 611 Hansen Way, Palo Alto, Calif. (BWO) 94304
99779	Barnes Dev. Co., 213 W. Baltimore Pike, Lansdowne, Pa. 19050
99942	Hoffman Electronics Corp., Semiconductor Div., Box 471, El Monte, Calif.

SECTION 6

PARTS LIST

List of Assemblies for Model 650 TA

Circuit Reference	Alfred Part No.	Description	Schematic
		Plug-in Chassis Assembly	D907389
A11	951918	Tube Mounting Assembly	D907389 ×
A12	951983	Elevated Supply PC Board Assembly	D907389 ×
A13	901298	Diode Shaper PC Board Assembly	C900837
A14	951984	Component Board Assembly	D907389 ×
A25	950278	HV Feedback PC Board Assembly	D907389 ×

× Part of Schematic listed

Plug-in Chassis Assembly

CIRCUIT REFERENCE	ALFRED PART NO.	DESCRIPTION	TRUE MFR. FMC NO.	TRUE MFR. PART NO.
		CONNECTORS, Jacks		
J1	133-62	10 contact; 2.9 KVDC, 7.5 amp.	81312	KZ 10S
J2 thru J5	131-UG-1094	BNC, UG 1094/U	94375	UG 1094/U
		CONNECTORS, Plugs		
P1 thru P5		Not used		
P6 and P7	133-71	16 contacts	74868	26-159-16
		RESISTORS		
R1	56-332 Ω	Fixed, met. film, 332 Ω, 1/2 w, ±1%	19701	MF7C-3320-F
R2 (Part of S5)	71-97	Variable, 10K, 1/2 w, ±10%	71450	VF-45-38082
R3 and R4	56-15K	Fixed, met. film, 15K, 1/2 w, ±1%	19701	MF7C-1502-F
R5	41-10M	Fixed, comp., 10M, 1/2 w, ±10%	01121	EB 1061
R6	42-3.3K	Fixed, comp., 3.3K, 1 w, ±10%	01121	GB 3321
		SWITCHES		
S1 and S2	101-7	Pushbutton	81073	2201
S3	102-144	Rotary, H.V., (650-2001)	71450	55475
S4	102-29	Rotary	71450	2-217-500314
S5 (Part of R2)	(71-97)	DPST, rotary snap	(71450)	(VF-45-38082)
		TEST POINTS		
TP1 thru TP6	133-28	Tip jack, red	74970	105-802
TP7	133-29	Tip jack, black	74970	105-803
TP8 thru TP17	(133-28)	Same as TP1	(74970)	(105-802)

A11 Tube Mounting Assembly Assy. 951918

CIRCUIT REFERENCE	ALFRED PART NO.	DESCRIPTION	TRUE MFR. FMC NO.	TRUE MFR. PART NO.
		CAPACITORS		
A11C1	12-34	Fixed, ceramic, .1 µf, 100V	91418	BT 010
A11C2	12-3	Fixed, ceramic, .01 µf, 1KV	56289	DD 1032
		DIODES		
A11CR1	81-20	1N4385	76433	1N4385
		RESISTORS		
A11R1 and A11R2	41-100 Ω	Fixed, comp., 100 Ω, 1/2 w, ±10%	01121	EB 1011
A11R3 and A11R4	41-1K	Fixed, comp., 1K, 1/2 w, ±10%	01121	EB 1021
		TUBES, Electron		
A11V1 and A11V2	111-8068	8068	33173	8068
		SOCKETS, Tube		
A11XV1 and A11XV2	136-20	Octal	71785	8EM

A12 Elevated Supply PC Board Assembly Assy. 951983

CIRCUIT REFERENCE	ALFRED PART NO.	DESCRIPTION	TRUE MFR. FMC NO.	TRUE MFR. PART NO.
		CAPACITORS		
A12C1	12-1	Fixed, ceramic, 15 pf, 600V	72982	831-U2JO-150J
A12C2 and A12C3	12-3	Fixed, ceramic, .01 µf, 1KV	56289	DD 1032
		DIODES		
A12CR1 and A12CR2	81-20	1N4385	76433	1N4385
		INDUCTORS		
A12L1	92-22	Coil, RF, 33 µhy	71895	1537-52
		TRANSISTORS		
A12Q1	81-72	2N699	96214	2N699
		RESISTORS		
A12R1 and A12R2	35-750 Ω	Fixed, met. film, 750 Ω, 2 w, ±5%	16299	C42-750Ω-5%
A12R3	35-1K	Fixed, met. film, 1K, 2 w, ±5%	16299	C42-1K-5%
A12R4	42-18K	Fixed, comp., 18K, 1 w, ±10%	01121	GB 1831
A12R5	41-1.8K	Fixed, comp., 1.8K, 1/2 w, ±1%	01121	EB 1821
A12R6	41-10 Ω	Fixed, comp., 10 Ω, 1/2 w, ±10%	01121	EB 1001
A12R7	56-237K	Fixed, met. film, 237K, 1/2 w, ± 1%	19701	MF7C-2373-F
A12R8	56-102K	Fixed, met. film, 102K, 1/2 w, ±1%	19701	MF7C-1023-F
A12R9	56-750K	Fixed, met. film, 750K, 1/2 w, ±1%	19701	MF7C-7503-F
A12R10	56-9.76K	Fixed, met. film, 9.76K, 1/2 w, ±1%	19701	MF7C-9761-F
A12R11	42-100K	Fixed, comp., 100K, 1 w, ±10%	01121	GB 1041
A12R12	42-120K	Fixed, comp., 120K, 1 w, ±10%	01121	GB 1241

A13 Diode Shaper PC Board Assembly Assy. 901298

CIRCUIT REFERENCE	ALFRED PART NO.	DESCRIPTION	TRUE MFR. FMC NO.	TRUE MFR. PART NO.
		CAPACITORS		
A13C1 thru A13C3	12-34	Fixed, ceramic, .1 µf, 100V	91418	BT 010
A13C4	12-22	Fixed, ceramic, 100 pf, 500V	72982	831-X5R-101K
A13C5 and A13C6	(12-34)	Same as A13C1	(91418)	(BT 010)
		DIODES		
A13CR1 thru A13CR11		Not used		
A13CR12 thru A13CR14	81-41	1N459	93332	1N459
		TRANSISTORS		
A13Q1 and A13Q2	81-115	2N3565	07263	2N3565
		RESISTORS		
A13R1*	56-309K	Fixed, met.film, 309K, 1/2 w, ±1%	19701	MF7C-3093-F
A13R2	56-21.5K	Fixed, met.film, 21.5K, 1/2 w, ±1%	19701	MF7C-2152-F
A13R3 thru A13R24		Not used		
A13R25	56-1K	Fixed, met. film, 1K, 1/2 w, ±1%	19701	MF7C-1001-F
A13R26	71-90	Variable, WW, 200 Ω, 20 turns	21030	70PR200
A13R27	41-1.8K	Fixed, comp., 1.8K, 1/2 w, ±10%	01121	EB 1821
A13R28	71-94	Variable, WW, 5K, 20 turns	21030	79PR5K
A13R29*	56-17.8K	Fixed, met. film, 17.8K, 1/2 w, ±1%	19701	MF7C-1782-F
A13R30	41-10K	Fixed, comp., 10K, 1/2 w, ±10%	01121	EB 1031
A13R31	41-150K	Fixed, comp., 150K, 1/2 w, ±10%	01121	EB 1541

A14 Component Board Assembly 951984

CIRCUIT REFERENCE	ALFRED PART NO.	DESCRIPTION	TRUE MFR. FMC NO.	TRUE MFR. PART NO.
		CAPACITORS		
A14C1	16-1	Fixed, plastic, .1 µf, 5KV	99120	OF50-104
		RESISTORS		
A14R1	42-470 Ω	Fixed, comp., 470 Ω, 1 w, ±10%	01121	GB 4711
A14R2	71-154	Variable, 500 Ω, 2 w, ±10%	71450	BH91963

A25 HV Feedback PC Board Assembly 950278

CIRCUIT REFERENCE	ALFRED PART NO.	DESCRIPTION	TRUE MFR. FMC NO.	TRUE MFR. PART NO.
		CAPACITORS		
A25C1	12-30	Fixed, ceramic, 1.5 pf, 6KV	56289	60GA-V15
		RESISTORS		
A25R1 thru A25R6	52-464K	Fixed, met. film, 464K, 1 w, ±1%	19701	MFS1-4643-F

SECTION 7

SCHEMATICS

Schematics are included in the following order:

PLUG-IN CHASSIS ASSEMBLY (Including Assemblies A11, A12, A14, & A25) D907389

DIODE SHAPER PC BOARD ASSY. 901298 C900837

*Factory Select

SHIPMENT DAMAGE CLAIM

The instrument should be tested as soon as it is received. If it fails to operate properly or is damaged in any way, a claim must be filed with the carrier. Have carrier agent inspect damage to instrument and packing crate and forward us a copy of his written report. You will then be advised of replacement or repair arrangements and disposition of the equipment. Please include model number, type number and serial number when referring to this instrument for any reason.

REPACKING FOR SHIPMENT

The instrument should be packed in the original carton. If unusable or not available, use a wooden box with approximately three inches of excelsior or other shock-absorbing material surrounding the instrument. If desired, packing services of a local transfer and storage company may be employed.

SINGER
INSTRUMENTATION

CHAMPION CLASP NO. 55
6 x 9